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MEMORANDUM

RM-3384-PR

JANUARY 1963

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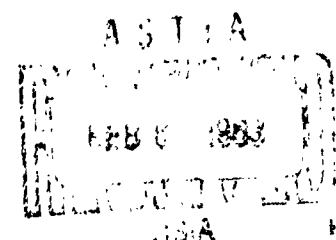
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SOVIET EXPENDITURES ON SCIENTIFIC RESEARCH

Nancy Nimitz

PREPARED FOR:

UNITED STATES AIR FORCE PROJECT RAND



The **RAND** *Corporation*
SANTA MONICA • CALIFORNIA

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PREFACE

Soviet data on the distribution of funds budgeted to science between 1950 and 1957 fail to account for all expenditures. The unidentified or "classified" portion grows far more rapidly than identified outlays, rising to 60 per cent of the total.

Not all "classified" budget outlays on science are necessarily for security classified research, nor is all research financed from the budget allocation to science. Hence unidentified outlays cannot be equated with total expenditures on space and weapons research. The presumption is nevertheless strong that they consist largely of defense-related outlays.

This Project RAND Memorandum examines evidence from the open Soviet literature bearing on the nature of unidentified outlays, and presents annual estimates of budget and other expenditures on research from 1928 through the 1962 Plan, together with background information on the research establishment and channels of financing. It relies upon Soviet statistical handbooks, budget reports, governmental decrees, and monographic and journal sources available in September 1962.

The Memorandum is part of a continuing study of the economic background of Soviet military and technological strength. It is addressed to those concerned either with the cost of the Soviet defense effort or the direction of Soviet scientific effort. Some of the evidence considered is unavoidably detailed, and is intended primarily for the specialized reader. Those interested in conclusions rather than methodology and sources will find all substantive results in the summary.

The author has profited from the critical comments of RAND colleagues Hans Heymann, Jr., Joseph E. Loftus, and Andrew W. Marshall, and from conversations with Professor Leon Trilling, a RAND consultant and member of the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology.

SUMMARY

The bulk of Soviet basic and applied research is performed in research institutions (rather than colleges and universities). Development of finished hardware and production processes is the function of design organizations and plant laboratories. Figure 1 shows the main trends in the growth of the research establishment from the beginning of World War II.¹

Since 1940 the total number of scientists has quadrupled. A rising proportion of the increase has gone to research institutions, which took 56 per cent of the increment between 1940 and 1955, and 79 per cent of the increment between 1955 and 1961. By 1961 the number of research scientists was 9 times the prewar level, and more than double the 1955 level. About one-fifth of the research scientists are in the USSR and republican academies of sciences (where basic research is concentrated), close to two-fifths are in industrial research institutions, and the remainder are in institutions controlled by nonindustrial ministries and departments in the fields of agriculture, health, and the like.

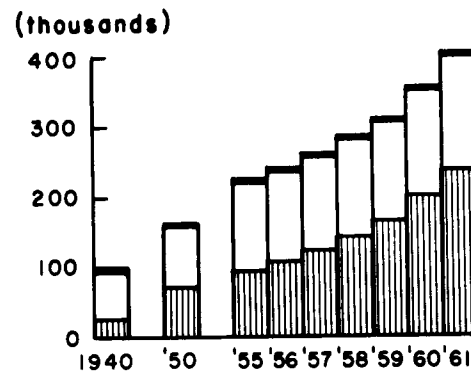
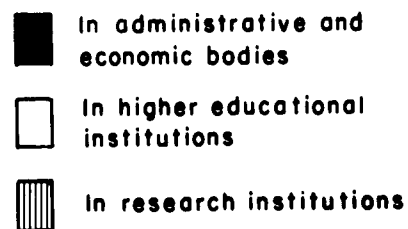
In terms of size and quality of personnel, the most important type of scientific institution is the research institute (NII). Since 1940 the number of these has more than doubled.

Since 1940 total employment in all phases of R&D has increased more rapidly than in any other readily identifiable sector of the economy. In 1961 R&D employment was almost 6 times the prewar level, and 2.6 times the 1955 level. The proportion of qualified scientists, engineers, and technicians in total employment has risen from one-quarter in 1940 to about one-half in 1961.

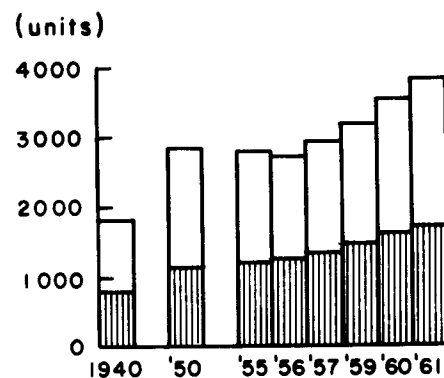
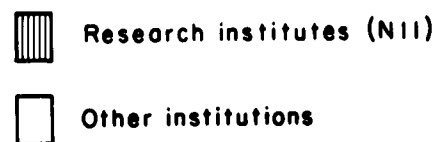
A small part of R&D is financed by economic enterprises and charged to cost of production. The greater part is financed by the

¹Figure 1 is based on Tables 2 and 7.

Scientists



Research institutions



Total employment in R & D

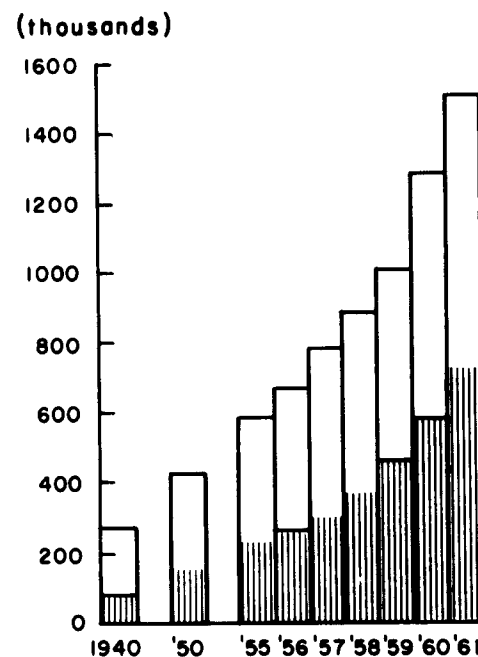
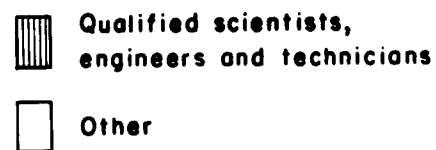


Fig. 1— Growth of the research establishment, 1940-1961

budget, primarily in the allocation to science, but also from the allocations to higher educational institutions and to the national economy.

Figure 2 shows total outlays on R&D from 1950 to 1961.¹ Though the data are in current rather than constant rubles, they should not seriously distort real trends in the volume of resources going to research.²

Between 1950 and 1961 total outlays on science from all sources (including unspecified budget sources) increased more than four-fold: from 9 to 38 billion rubles.³ The budget allocation to science increased five-fold: from 5.4 to about 27 billion rubles. Unidentified or "classified" budget outlays on science rose from 2.3 billion rubles in 1950 to 8.1 billion in 1957; if the pattern of expenditures in previous years has persisted, unidentified outlays in 1961 were on the order of 16 to 17 billion rubles, or 7 times the 1950 level.

These unidentified outlays on science are from the all-Union budget, which finances research institutions of national as distinguished from republican or local significance. Trends in the distribution of the all-Union budget imply that the identified portion supports the Academy of Sciences and other nonindustrial institutions, while the "classified" portion consists mainly if not entirely of outlays on industrial research. If this interpretation is correct, research directly addressed to space and defense problems must be concentrated in unidentified outlays (along with some civilian industrial research of the highest priority).

¹Figure 2 is based on Tables 8 and 9.

²The same cannot be said of current ruble data for the preceding decade, which reflect a large wage increase in 1946, and increases in the prices of nonwage inputs in 1946-1947 and 1949.

Over the period 1950-1961, the annual increase in the average R&D wage is not likely to have exceeded 2 to 3 per cent, and through 1955 this increase was probably offset by decline in the prices of nonwage inputs. From 1956 on, prices of nonwage inputs were generally stable.

³All value data in this study are given in old (pre-1961) rubles, equivalent to one-tenth of the present ruble.

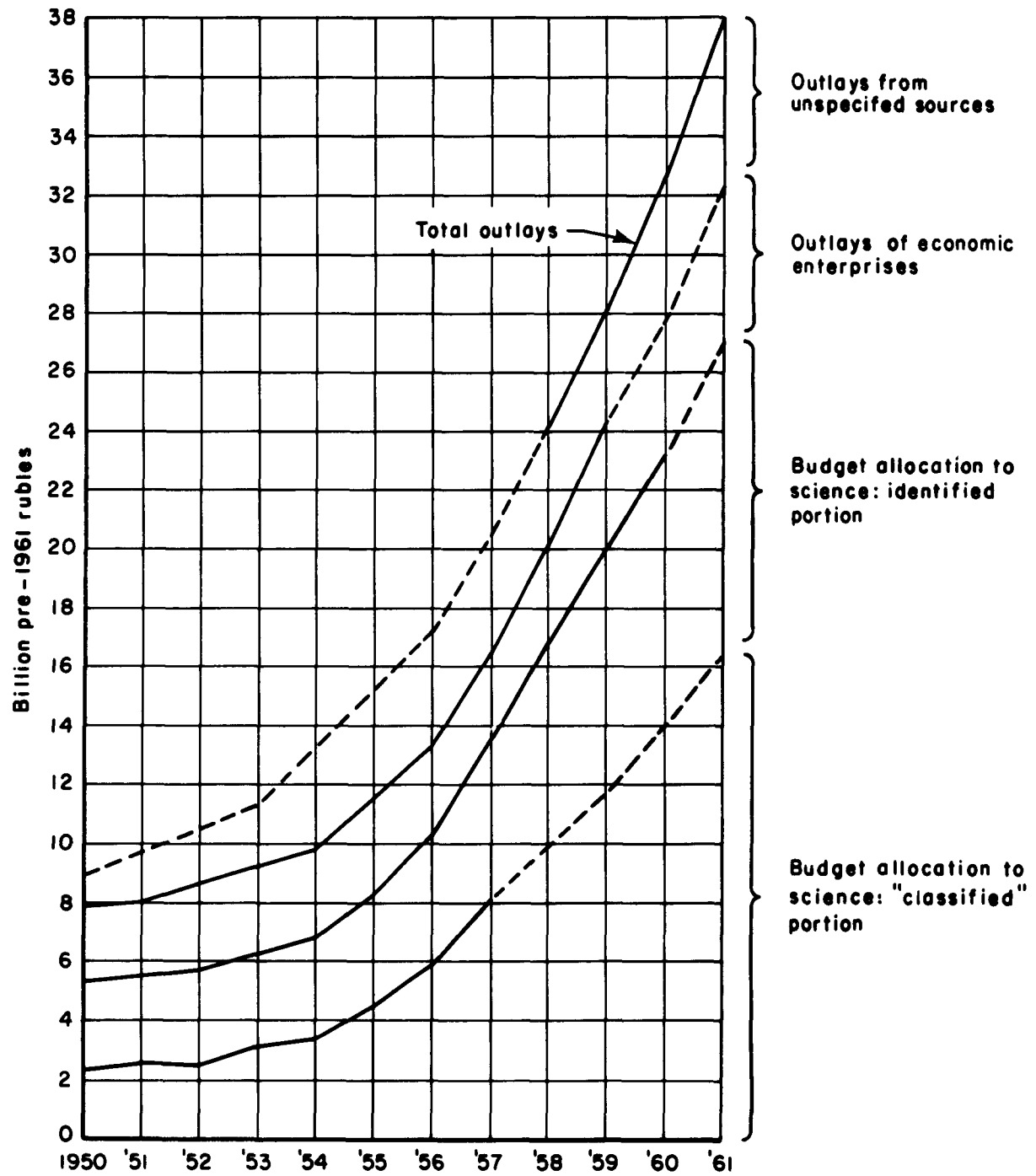


Fig. 2 — Outlays on research, 1950-1961

Comparison of trends in outlays with trends in the number of scientists in research institutions suggests a radical increase between 1955 and 1960 in nonwage outlays on all-Union industrial research. Over this period, when the increase in the industrial research wage bill was on the order of 50 per cent, nonwage outlays may have increased three-fold. Since prices of nonwage inputs were stable, the increase indicates a shift toward types of research where investment or development costs are very high.

The rise in nonwage outlays helps to explain recent Soviet sensitivity about the cost of research. Until the 1960's there was no explicit public admission that some research projects are extremely expensive, that lesser projects must be sacrificed to priority projects, and that research in general competes with other sectors for resources. Statements made during the last two years indicate a new concern with economic use of the research ruble.

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I. THE RESEARCH ESTABLISHMENT

Science (nauka) in Soviet usage comprises not only the physical and biological sciences but also the social sciences and humanities. The relative importance of the latter in terms of personnel is indicated in Table 1, which shows the change in the distribution of the total stock of scientists or scholars by discipline between 1955 and 1960.¹ Over these years the maximum share of scholars in the social sciences and humanities declined from 29 to 24 per cent. Among scientific personnel in research institutions (as distinguished from colleges and universities) their proportion is considerably smaller--on the order of 10 to 15 per cent.

SCIENTISTS

Scientists (nauchnye rabotniki) are specialists engaged in teaching or research in colleges and universities² and in research institutions; a few are also employed in administrative and economic organizations (see Table 2).³ The term is not precisely defined: ideally it implies graduate training, but the decisive factor in most cases is not education per se but the type of work done. According to a manual of statistical practice, the following are classified as scientists at the present time: (1) all members and corresponding members of the general and specialized academies of science; (2) all persons in higher educational and research institutions who are engaged in instruction or planned research, whether or not they

¹Tables are placed at the end of the text.

²By college is meant the specialized higher educational institutions (instituty) which provide 4- to 6-year training for professions in industry, construction, transport, agriculture, economics, law, medicine, and so on. A more correct term would be institute, but since this is liable to confusion with the research institute (nauchno-issledovatel'skii institut), the misnomer college is preferred for present purposes. Universities differ from the specialized colleges by the diversity of training provided and by the emphasis on theoretical disciplines.

³Fed'kin-58, pp. 212-213; Trudovoe pravo, entsiklopedicheski slovar', Moscow, 1959, p. 245. Sources cited in abbreviated form are listed in full on pp. 63-64.

have an advanced degree or academic title; (3) all persons with advanced degrees or academic titles working in any institution, regardless of the character of the work in which they are engaged.¹

Three points about recent trends in scientists should be noted: since 1955 the total number has increased by 80 per cent (Table 2);² the lion's share of the increase has gone to research institutions, rather than colleges and universities; the increase has been concentrated in the engineering disciplines (Table 1).

¹S. G. Strumilin, et al., Statistika, Moscow, 1956, pp. 250-251. See also M. R. Eidel'man (ed.), Uchebnoe posobie po otdel'nyim otrasliam statistiki, Moscow, 1958, p. 102.

The degree of candidate of sciences (kandidat nauk) normally requires three years of graduate work and the public defense of a dissertation. In many disciplines it appears to be comparable to an American Ph.D. The highest degree, doctor of sciences (doktor nauk), requires either the defense of a doctoral dissertation or conspicuous scientific accomplishment; it is typically earned at a considerably later age than the American Ph.D. See Fed'kin-58, pp. 231-236; Trudovoe pravo, entsiklopedicheskii slovar', Moscow, 1959, pp. 27-28, 468. For a discussion of the comparability of American and Soviet degrees, see Alexander G. Korol, Soviet Education for Science and Technology, New York, Technology Press of M.I.T. and John Wiley, 1957, pp. 390-393.

Academic titles involve three ranks. The highest rank in both research institutions and higher educational institutions is that of professor (normally a doctor of sciences). The second and third ranks in research institutions are designated senior scientist (starshii nauchnyi sotrudnik) and junior scientist (mladshii nauchnyi sotrudnik); in educational institutions the comparable titles are docent (dotsent) and instructor or lecturer (assistent). Senior scientists and docents normally have a candidate degree; junior scientists and instructors must have at least a diploma from a college or university. See Fed'kin-58, pp. 242-245; BSE, 2d ed., v. 44, p. 453.

²It is not clear whether this rapid increase was associated with a decline in the average level of qualifications. The proportion of scientists holding advanced degrees did fall from 39 per cent in 1955 to 28 per cent in 1961 (NKh-55, p. 233; Tsif. -61, p. 332). However, this trend is perhaps explained by the stricter requirements introduced in 1956 for dissertations (see Vys. shkola-57, pp. 285-287). As a result of the new requirements, the number of candidate dissertations defended dropped from 11.8 thousand in 1955 to 3.5 thousand in 1957 (Komarov-59, p. 120). Over the same period the outturn of graduate students (that is, the number of students who have completed their formal studies and passed the candidate examinations in their specialty) rose from 7.6 thousand to 8.2 thousand (NKh-58, p. 848).

RESEARCH INSTITUTIONS

Colleges and universities apart, institutions engaged in research fall into three groups, each identified in principal with a different research function. Basic research is concentrated in the USSR and republican academies of sciences, which are subordinated to the USSR and republican councils of ministers. Applied research is the responsibility of the specialized academies of sciences (agricultural, medical, and the like) and of the specialized or "branch-of-industry" (otraslevye) research institutes controlled by individual ministries and economic administrative bodies. Development of production processes and finished hardware is the task of design organizations and the laboratories attached to individual plants.¹ In practice this division of responsibilities has been blurred: both the USSR Academy of Sciences and the republican academies have engaged in a considerable amount of technical or applied research, while design organizations have reportedly been compelled from time to time to cope with theoretical problems neglected by research institutes.

In contrast to the United States, colleges and universities in the USSR have so far played a comparatively minor role in research. A 1955 source complained that "barely one-fifth" of the professors and instructors in higher educational institutions were participating in research work, and that many faculty research projects were "trivial and isolated."² Part of the explanation for this lag lies in the rapid development during the Soviet period of the specialized research institutes, which competed with colleges for scientific personnel and equipment. Mounting college enrollments placed a heavy load on

¹Fed'kin-58, pp. 42-43.

²Izvestiia, 5 Oct. 1955, p. 1, as translated in Current Digest of the Soviet Press, v. 7, no. 40, p. 23.

teaching staffs which left little time for research.¹ Evidently faculty research has also been inhibited by the disparity between risks and rewards,² and by meager funds.³

A 1956 decree prescribed various improvements in the planning and organization of college and university research, and authorized an expansion of physical facilities; in particular, it provided for equipping colleges with research laboratories in which urgent theoretical and design problems could be studied, and for transferring to colleges some formerly independent research institutes.⁴ By July 1961 higher educational institutions were reported to have about 300 "problem" and specialized laboratories, and 32 research institutes.⁵

The distribution of research institutions by type in 1955 (the latest year for which detailed data are available) is shown in Table 3. The data exclude colleges and universities as such, but evidently include their research institutes;⁶ similar statistics for later years may include the new problem laboratories as well.⁷ Laboratories and other scientific facilities at industrial plants are probably excluded, unless they are unusually large or important.

¹Fed'kin-58, pp. 162-163.

²According to Fed'kin-58, p. 167: "...A major research project undertaken by a professor or instructor ... may create a host of 'inconveniences' for its author if the work goes slowly or unsuccessfully, yet brings him no material or other advantages over teachers who restrict their scientific plans to preparing documentation or teaching guides for some course at the college. At present the salary of faculty members is in no way connected with the amount and quality of research work done."

³According to the rector of Leningrad University, average research funds per scientist are 7 to 8 times larger in the USSR Academy of Sciences than in a university (Pravda, 8 Feb. 1961, p. 3).

⁴Vys. shkola-57, pp. 215-219.

⁵Eliutin (USSR Minister of Higher and Specialized Secondary Education) in Pravda, 5 July 1961, p. 6.

⁶See note d to Table 4.

⁷In Table 2, the increase in numbers of "other" research institutions between 1955 and 1960 is compatible with the inclusion of problem laboratories.

In terms of personnel, the most important types of research institutions are institutes (including branches) and scientific stations, which together account for 85 per cent of the scientists in Table 3. A rough idea of the distribution of institutes and stations by type of research and subject field can be formed from Table 4, which classifies them by controlling bodies. A little over one-fifth of the institutions and scientific personnel in Table 4 are controlled by the general academies of sciences, and may therefore be identified primarily (though by no means exclusively) with basic research. The distribution by discipline of the academy scientists is not available; guessing crudely from a partial distribution of institutes under the USSR Academy of Sciences (note b to Table 4), the natural and technical sciences may account for four-fifths or more of the total. The specialized institutions controlled by ministries and economic bodies are those concerned primarily with applied research; among these the natural and technical sciences account for about nine-tenths.

Jurisdictional data for years since 1955 are complete only for the general and specialized academies (Table 5). In 1960 the general academies continued to account for about one-fifth of the total number of research scientists, while the specialized academies had one-tenth, and institutions controlled by industrial bodies (ministries, Gosplan, specialized committees, regional economic councils) had 37 per cent. The remainder (about one-third) were presumably employed in specialized institutions controlled by nonindustrial ministries and departments.

The proportion of research scientists employed in the general academies may have declined slightly in 1961, following a decree which reaffirmed their responsibility for basic and theoretical (as distinguished from technical) research, and which established a new state committee to coordinate the planning and execution of research.¹

¹The decree was published in Pravda, 12 April 1961. For a discussion of the debate which preceded it, see DeWitt-61.

The implications of the decree are not entirely clear,¹ but it is known that by June 1961 the USSR Academy of Sciences had been divested of about 30 research institutions engaged primarily in engineering research.²

EMPLOYMENT IN RESEARCH INSTITUTIONS

The only Soviet figure for total employment in research institutions (including not only scientists but also engineers and other specialists with college-level training, laboratory and other technicians, and miscellaneous auxiliary personnel) refers to 1 April 1935: 146,130.³ Employment on 1 January 1939 can be estimated from incomplete data as about 140 to 150 thousand.⁴ Soviet employment statistics for other years lump research institutions with other unspecified scientific employment (see Table 2); since 1955 this unspecified aggregate has increased by about 150 per cent.⁵

From the enumeration of the science grouping in published distributions of specialists employed in the national economy (the

¹Ostensibly the Academy is "liberated" from any concern for technical research, but Professor Leon Trilling has speculated that it has also lost "some of its independence as well as authority" (Newsweek, 5 June 1961).

²DeWitt-61, p. 1987.

³TsUNKhU, Trud v SSSR, Moscow, 1936, pp. 28-29.

⁴Employment in 684 institutes (out of a USSR total of 694) and 61 branches (out of a total of 63) amounted to 108,522 (Kul't. stroi. -40, p. 238); the total for all institutes was perhaps 110 thousand. Employment of scientists and engineers (only) in scientific stations may be estimated as 6 thousand (ibid., p. 231) and in all other institutions as about 5 thousand (derived from numbers of other institutions, ibid., p. 231, and the average per institution in 1935, as implied in TsUNKhU, Sotsialisticheskoe stroitel'stvo SSSR, Moscow, 1936, p. 589). Assuming that scientists and engineers accounted for 32 per cent (as in institutes and branches), total employment in scientific stations and other institutions was about 34 thousand ($11 + 32/100$).

⁵In statistical handbooks published before 1959, the aggregate was classified in distributions of total USSR employment under "Education" (prosveshchenie), which was usually specified as including "schools, educational institutions, scientific-research and cultural institutions." See NKh-56, pp. 204-205; NKh-58, pp. 658-659, note.

group comprises "scientific and research institutions, project, design, and geological survey organizations"),¹ it might appear that the unspecified residual in scientific employment includes employees of the project organizations (proektno-izyskatel'nye organizatsii) which draft technical specifications for all kinds of construction.² However, distributions of total USSR employment in the statistical handbooks for 1959 and 1960 indicate that such project personnel are classed not with "Science..." but in a catchall category (prochie otrasli) specified as including "capital repair, drilling, project organizations, and other (branches)."³ From the groupings used in a Central Statistical Administration table showing educational qualifications of women in various occupations, it may be inferred that the "Science..." category includes only those project personnel not involved in routine construction.⁴

It is fairly certain that the "Science..." category does include the design organizations (konstruktorskie organizatsii) which develop new machinery. According to Iu. E. Maksarev, vice-chairman of the State Scientific and Technical Committee in 1960, "about 800 thousand workers are employed at the present time in project and design work, of which about 300 thousand are in project organizations."⁵ Thus employment in design organizations amounted to about 500 thousand. Maksarev's figures evidently refer to 1959, judging from the following

¹For example, NKh-58, p. 675.

²At the end of 1960 there were 1,128 such organizations, of which 735 were subordinated to republican bodies and 393 to all-Union bodies (ministries, state committees, etc.). See Kap. stroi. -61, pp. 264, 269.

³NKh-59, p. 589; NKh-60, p. 637.

⁴TsSU, Zhenshchiny i deti v SSSR, Moscow, 1961, pp. 77, 80. "Project organizations serving construction" are distinguished from "Design and project organizations not serving construction". Only the latter are grouped with "Science..."

⁵Vestnik statistiki, 1960 no. 8, p. 18.

precise data for average annual employment in project organizations serving construction (1,000):¹

1950	160
1955	235
1956	251
1957	261
1958	285
1959	303
1960	346

On the provisional assumption that research institutions and design organizations account for the bulk of the unspecified residual under the employment category "Science and Scientific Services" (which amounted to about 1,000 thousand in 1959: see Table 2), total employment in basic and applied research institutions in 1959 may be estimated at about 500 thousand (1,000 less 500 in design or development organizations).

Clues to the composition of employment are given in Table 6, which provides data on administrators and specialists in research institutions and quasi-scientific organizations. According to the source, "administrators" are directors and assistant directors of institutions or their subdivisions; "specialists" are those occupying positions normally (though not necessarily) filled by persons with higher or specialized secondary education. Thus, Table 6 excludes many employees with general secondary or lower education (though it does include some "practicals": see note d). It also designates as administrators many persons who must also be scientists, and contains unspecified residuals. Perhaps for these reasons, the number of identified scientists in research institutions on 1 January 1957 (58 thousand nauchnye sotrudniki) is far below the total given for 1 October 1956 in Table 2 (106 thousand nauchnye rabotniki). If all the 34 thousand administrators are scientists, and if the unspecified residual of 18 thousand consists of scientists who do not

¹Kap. stroi. -61, p. 268.

hold the academic rank of nauchnyi sotrudnik, the apparent discrepancy is explained.¹

The data presented so far, plus information on employment of persons with higher or specialized secondary education, provide the basis for the total employment estimates in Table 7. The columns of prime interest are (1) research institutions and (5) design organizations, which together comprise "research and development" in western usage. Their joint total (rounded) is shown in Col. (8). Assuming that most persons now classified as scientists are included in the data for specialists with higher education, the composition of total R&D employment in 1960 may be estimated as follows (in thousands):

Scientists	200
Other professionals with higher education (primarily engineers)	180
Semiprofessionals with specialized secondary or technicum education (technicians, laboratory workers, bookkeepers)	200
All others ("practicals" in technical positions, production workers, clericals, etc.)	700
<u>Total</u>	1,280

In evaluating these figures it should be borne in mind that many of the scientists--perhaps as many as one-half--are specialists in the "technical sciences,"² and therefore have an engineering background.

¹This hypothesis is supported by a distribution of scientists in research institutions on 1 October 1960 (Vestnik statistiki, 1962, no. 4, p. 67). Of the total of 200.1 thousand nauchnye rabotniki, 41 thousand were classified as administrators (nauchno-rukovodiashchii personal), 104 thousand had positions normally occupied by starshie and mladshie nauchnye sotrudniki, while the remaining 55 thousand were classified as "scientific-technical and scientific-auxiliary personnel and specialists" (nauchno-tehnicheskii, nauchno-vspomogatel'nyi personal i spetsialisty). It might be noted that of the 104 thousand occupying nauchnyi sotrudnik positions, not more than 47 thousand formally held the academic titles of starshii or mladshii nauchnyi sotrudnik (see Tsif. -61, p. 332).

²The proportion among all scientists was 37 per cent (see Table 1). The proportion in research institutions was undoubtedly higher.

II. FINANCING RESEARCH

Though data on scientific employment and specialist personnel group research and design institutions with various other quasi-scientific organizations, "science" as an object of expenditure seems to refer essentially to R&D: the term excludes outlays on geological surveying and project organizations serving construction, and probably hydrometeorological services as well.¹

CHANNELS OF FINANCE

Known sources of expenditures on R&D are listed below:

(1) Research related to the production of an individual enterprise or a narrow branch of industry is financed by the enterprises concerned and charged to cost of production.² Such research may be performed either by the laboratories and design offices attached to enterprises, or (on contract) by research institutes and higher educational institutions.

(2) Research which is of broad industrial significance or non-industrial in nature is financed by the government budget, primarily from the allocation to "science" but also from the allocation to "higher educational institutions". Both of these allocations are

¹Outlays on geological surveying are either charged to construction costs (if they are associated with specific capital projects) or classified as "operational outlays" and financed by the budget under the allocation to the national economy (see D. A. Allakhverdian (ed.), Finansy SSSR, Moscow, 1958, p. 251; V. V. Lavrov and others, Finansirovanie otraslei narodnogo khoziaistva, Moscow, 1956, pp. 83-34). Outlays of project organizations have been covered either by charges to construction costs or (from 1950 to 1959) by the budget allocation to the national economy (Allakhverdian, op. cit., p. 250; NKh-58, p. 619, note); for their outlays over the period 1951-1960 see Kap. stroi. -61, p. 270. No information on the financing of hydrometeorological work has been located, but the routine services are analogous to others financed by funds budgeted to the national economy.

²O. Hoeffding and N. Nimitz, Soviet National Income and Product, 1949-1955, The RAND Corporation, RM-2101, 6 April 1959, pp. 126-127; Vysshaia partiinai shkola, Ekonomika sotsialisticheskikh promyshlennykh predpriatii, Moscow, 1959, pp. 349, 447, 449; Nar. obraz. -57, pp. 780-781.

part of the funds budgeted to "education," which in turn comes under the major budget category "social and cultural measures" (comprising education, health, and various pensions and allowances).

(3) Capital investment in construction and equipment of research institutes has been financed in part by funds budgeted to economic bodies under the major budget category "national economy."

Of these sources, by far the most important has been the budget allocation to "science" (or, in the usage of older budget sources, to "research institutions"): it accounted for 60 per cent of the reported total in 1950 and 71 per cent in 1960 (see Table 8, Cols. (1) and (3)). Over the same period the share of enterprise-financed expenditures (Col. (4)) dropped from 28 per cent to something like 15 per cent.

Expenditures on research from funds budgeted to "higher educational institutions" cannot be reliably estimated, but the amount can hardly have exceeded 1.5 billion rubles in 1960.¹ Whether expenditures from this source are included in Col. (1) of Table 8 is not known. (They are explicitly excluded from the more restricted series for "total" outlays in Col. (2).) However, the contract research performed at colleges and universities for industrial and other enterprises (and financed by fees paid by the enterprises) presumably is included in Col. (4) and hence in both Cols. (1) and (2). Such research amounted to 300 million rubles in 1958 and was expected to rise to 750 million by 1965.²

¹According to DeWitt-61, p. 1963, about one-third of the scientists in higher educational institutions in January 1960 were actively engaged in research. Assuming that research took half of their time, one-sixth of the scientist wage bill can be attributed to research. Given a total wage bill (for scientists and others) of about 4.9 billion rubles (estimated from Biudzhety-62, pp. 48, 84), the amount attributable to research is not more than 0.8 billion rubles. Wage outlays probably accounted for at least half of total research outlays (see Table 11).

²Komarov-59, pp. 172-173.

No data on investment in research facilities from funds budgeted to the national economy (Col. (5)) are available for years after 1945. At that time the amount was equal to less than 2 per cent of "total" outlays (the restricted series in Col. (2)). The ratio may have increased in postwar years.¹

The scope of reported "total" outlays on scientific research was expanded in the 1959 Plan from the Col. (2) to the Col. (1) definition. Subsequently, revised totals for selected years before 1959 were published; the difference between the two series rises from 1.1 billion rubles in 1950 to 4 billion in 1959. It will be noted that the 1959 Plan figure for budget outlays on "science" represents an unusually large increase over the previous year, and that actual outlays were 3 billion rubles below plan. Evidently the Plan figure included budget outlays not ordinarily designated to science, while the actual figure was comparable with data for earlier years. Presumably the difference between Cols. (1) and (2) lies, then, in budget outlays not designated to science. These could be outlays from funds budgeted to higher educational institutions or to the national economy, or possibly even to defense (though the bulk of defense research is financed from the allocation to "science").²

DEFENSE RESEARCH

The inclusion of defense research among projects supported by the budget allocation to "science" is not ordinarily emphasized by the Russians, but there is ample reason to believe that it is financed there. Propaganda considerations aside, it is normal Soviet budgetary practice to classify operating outlays on education (which includes science) under "education," regardless of the ministry or

¹Nar. obraz. -57, p. 780, speaks of "large sums" (bol'shie sredstva) for this purpose in the postwar period, while the former Minister of Finance has referred to "large allocations" (krupnye assignovaniia) (A. G. Zverev, Natsional'nyi dokhod i finansy SSSR, Moscow, 1961, p. 160, note).

²Funds budgeted to defense might include, for example, expenditures on missile test sites classified as military facilities.

branch of the economy which the outlays may serve.¹ From the propaganda standpoint, it is clearly preferable to attribute outlays to education rather than defense wherever the choice exists. Finally, Soviet authorities on budgetary matters have explicitly mentioned defense in discussions of allocations to "science." In his speech on the 1945 budget plan, the Minister of Finance, A. G. Zverev, stated that "the creative work of our scientific institutions contributed considerably to the military might of the Soviet Union."² Under a table summarizing outlays on research institutions from 1928 through 1945, K. N. Plotnikov (at one time an official in the Ministry of Finance) noted that "the enormous creative enthusiasm which in the war years gripped scientists in absolutely every area of science enriched our country with discoveries of great importance, which helped us to overcome the enemy."³ Accounts of the activities of research institutions during the war leave no doubt that effort was concentrated on military research: "[Research] institutes, like industry, were evacuated [to the rear] so that they might be mobilized to the maximum and better serve the Soviet army..."⁴ In a discussion of postwar allocations to "science," Plotnikov singles out such feats as "the discovery of methods of producing atomic power and the achievement of a powerful thermonuclear reaction,"⁵ while V. V. Lavrov mentions the development of an intercontinental ballistic missile and the launching of earth satellites.⁶

Probably some of the research financed by funds budgeted to higher educational institutions has been related to defense, but the amounts involved cannot be large if total research expenditures from

¹V. A. Shavrin, Gosudarstvennyi biudzhets SSSR, Moscow, 1951, p. 25; Aleksandrov-61, p. 49.

²Zverev-56, p. 156.

³Plotnikov-48, p. 334.

⁴BSE, Soiuz sovetskikh sotsialisticheskikh respublik, Moscow, 1947, p. 1266. See also BSE, 2d ed., v. 50, 1957, p. 436.

⁵Plotnikov-54, p. 523.

⁶Finansy i sotsialisticheskoe stroitel'stvo, Moscow, 1957, p. 209.

this source are presently on the order of 1.5 billion rubles (as estimated in the preceding section). Possibly some fraction of enterprise-financed outlays (Col. 4 in Table 8) goes to R&D connected with the defense industries. However, defense research charged to cost of production is likely to involve only the standard types of military hardware: expenditures on new weapons systems are certainly financed from the budget. A merely intuitive guess is that the maximum share of enterprise-financed outlays going to research on military hardware is 25 per cent, which would amount to about 1 billion rubles at the present time.

UNIDENTIFIED BUDGET OUTLAYS ON SCIENCE

A statistical manual of the Soviet Ministry of Finance presents data on the distribution of budget outlays to "science," 1950-1957, by various expenditure categories: wages and other outlays related to personnel; office and maintenance expenses; instructional and research expenses; purchased materials; investment in equipment and construction; capital repairs. Two sets of data are presented, one referring to the consolidated budget for all levels of government (the gosudarstvennyi biudzheth) and the other to republican budgets (which include outlays at republican and lower levels). Subtraction of the republican from the consolidated budget data should yield expenditures from the all-Union (soiuznyi) budget, which embraces outlays of national as opposed to republican or local significance. As is shown in Table 9, the results of this calculation fall far short of accounting for total all-Union outlays (see Rows 19 and 32).

It might be argued that the categories in Table 9 need not exhaust all outlays on science. But they do nearly exhaust outlays from republican budgets: there, unidentified expenditures are negligible--on the order of 2 per cent. In the all-Union budget unidentified expenditures in 1957 amount to 75 per cent. Clearly, many research institutions financed by the all-Union budget are excluded from the data for expenditure categories.

The rest of this section is addressed to two interlocking questions: What institutions are excluded? What can we deduce about trends in all-Union industrial research (where space and defense projects must be concentrated)? Since the exposition is necessarily tortuous, the main lines of the argument are summarized below for readers who do not wish to go into the details.

After the kinds of institutions supported by the republican and all-Union budgets are defined, the outlay series in Table 9 are analyzed with particular attention to their behavior in 1957, when many branches of industry passed from all-Union to republican jurisdiction. Because the change had no apparent effect on identified all-Union outlays, it is inferred that they cover little if any industrial research.

The appealingly neat hypothesis that unidentified outlays are coextensive with industrial research cannot be rigorously tested. However, we know that about half of the all-Union research scientists in 1955 were engaged in industrial research, and we have good reasons to believe that outlays per scientist are higher there than in non-industrial branches. Therefore it is at least possible that unidentified outlays (which amounted to two-thirds of the all-Union budget in 1955) consisted wholly of industrial research. It is inescapable that they consisted mostly of industrial research if the inference that unidentified outlays are nonindustrial is correct.

If the hypothesis is true for both 1955 and 1960, we can calculate the absolute increase in all-Union budget outlays per industrial scientist: from about 130 thousand rubles to 280 thousand. If the hypothesis is erroneous, we can still deduce that the relative increase was at least two-fold. The trend implies a sharp increase in investment or development costs.

The presumably complete republican data in Table 9 cover budget outlays on: (1) the republican academies of sciences;¹ (2) specialized republican academies in the fields of education, communal economy, construction and architecture, and agriculture; (3) other nonindustrial research institutions controlled by republican ministries (for a list of the areas of republican jurisdiction see Cols. (2) and (3) in Table 10); (4) industrial research institutions controlled until 1957 by republican ministries, and thereafter mainly by regional economic councils and republican planning committees.

Institutions financed by the all-Union budget (but only partly covered by the detailed expenditure data in Table 9) include: (1) the USSR Academy of Sciences; (2) the four specialized USSR academies of Construction and Architecture, Agriculture, Medicine, and Fine Arts; (3) other nonindustrial research institutions controlled by all-Union bodies (see Cols. (1) and (2) of Table 10); (4) industrial research institutions controlled until 1957 by all-Union ministries, and thereafter by the three surviving industrial ministries, by specialized state committees which assumed some of the functions of abolished ministries, and by the State Planning Committee (which took over the leading or golovnye research institutes in branches of industry otherwise subordinated to regional economic councils).²

One clue to the coverage of the all-Union data is provided by Row (27) in Table 9. Except for 1951, identified all-Union outlays include expenditures on medication and bandages. In 1956 these expenditures amounted to 5 million rubles, compared with republican outlays of 23 million rubles. Evidently the data cover some if not

¹Since institutions of the USSR Academy of Sciences are concentrated in the Russian Republic, the RSFSR has no republican academy. However, the RSFSR republican budget may support the Siberian Branch of the Academy (see Finansy SSSR, 1960, no. 1, p. 22). Around 1961 some filials and institutes of the Academy were evidently transferred to RSFSR jurisdiction and financing (VAN, 1961, no. 7, p. 49).

²Fed'kin-58, pp. 148-149.

all the all-Union research institutions in the field of health. At the end of 1956 such institutions were distributed by jurisdiction as follows:¹

All-Union	68
Academy of Medical Sciences	26
Other	42
Republican	200

Other clues may be sought in changes in the level and structure of budget outlays (shown in percentage terms in Tables 11 and 12). Since capital expenditures may fluctuate erratically from year to year, trends in the volume of research activities are best inferred from operating outlays, and in particular from wages, which account for up to two-thirds of operating outlays (see Table 11). The average R&D wage probably rose from 1950 through 1958, so that wage data in current prices may overstate increases in "identified" employment and understate reductions; however, the wage increase in any one year is not likely to have exceeded 2 to 3 per cent. A slight decline in the average wage may have occurred in 1959-1960.²

¹Zdrav. -57, p. 164.

²In 1946 the average wage of scientists (nauchnye rabotniki) "more than doubled" (Nar. obraz. -57, p. 779). Basic salary scales of scientists apparently remained unchanged from that year through 1958. Reports of visitors to the USSR suggest that in 1959 the maximum salaries of professors, and perhaps of other ranks of research scientists, were rather substantially reduced. No reference to the reduction in Soviet sources has been encountered; however, there is published evidence of dissatisfaction before 1959 over "the striking disparity between salaries of scientists in research and academic institutions and those in enterprises" (Komsomol'skaia pravda, 20 March 1956, p. 2, as translated in Current Digest of the Soviet Press, v. 8, no. 13, pp. 4-5).

Wage data specifically referring to other categories of R&D employment are not available, but the over-all trend may have resembled the trend in the average industrial wage, which increased from 1950 to 1960 by about 2.5 per cent a year (Central Intelligence Agency, Average Annual Money Earnings in Soviet Industry, 1940-58, December 1960, p. 2; Finansy SSSR, 1961, no. 6, p. 9).

Tables 11 and 12 both suggest that the aggregate of research institutions covered by identified outlays from the all-Union budget was not entirely constant in the early 1950's. Operating outlays contracted in 1951 (when health research institutions were apparently excluded), expanded considerably in 1952 and contracted again in 1953 (see Rows (8) to (11) of Table 12). The declines in outlays were accompanied by shifts in the relative importance of wages and of outlays on "instruction and research," a category which in the case of research institutions must consist mainly of expenditures on research materials, testing, experimental models, and so on.¹ In both 1951 and 1953 the share of wages rose while the share of research materials and services fell (see Rows (12) and (13) of Table 11). From 1954 through 1957 identified operating outlays from the all-Union budget increased every year, while trends in the structure of outlays were constant in the sense that the share of wages steadily declined, while the share of research materials and services steadily rose.

The structure of republican outlays (Rows (4) to (7) of Table 11) was rather stable through 1956. In 1957, following the transfer of some research institutions from all-Union to republican jurisdiction, operating outlays jumped by 34 per cent (Row (2) of Table 12) while the structure of operating outlays changed significantly: the share of wages fell from 66 to 63 per cent, and the share of research materials and services rose from 14 to 19 per cent (Rows (5) and (6) of Table 11).

Four republics established academies of agricultural sciences in 1957, and it is clear that some of the institutions transferred from all-Union to republican jurisdiction were agricultural. However, only the Uzbek and Kazakh academies (which at the end of the year had a joint total of 74 research institutions with 1,707 scientists)² appear

¹See note c to Table 9. The classification of expenditures in Table 9 applies to all budget-supported institutions, not merely to research institutions.

²Tsif. -58, p. 366.

to have been formed primarily from institutions previously administered by the all-Union Academy of Agricultural Sciences,¹ and despite these transfers the number of scientists in the all-Union Academy increased during the year by 6 per cent.² Thus the bulk of the transfers to republican jurisdiction in 1957 evidently involved industrial research institutions, "hundreds" of which (according to one source) passed from the control of ministries to the regional economic councils.³ At least in the case of the Ukrainian SSR, industrial reorganization involved the transfer to republican budget support of a "large group" of research institutions formerly supported by charges to cost of production.⁴

The fact that industrial reorganization did not noticeably retard the growth or interrupt trends in the structure of identified all-Union budget outlays on research implies that identified outlays covered no industrial research institutions subject to transfer. This in turn raises the possibility that they covered no industrial research institutions at all, since (1) there is a presumption that research institutions are grouped by branch for budget accounting purposes, and (2) total all-Union budget outlays on industrial research must far exceed identified outlays.

The question of grouping requires a brief explanation of the classification of budget outlays. There are 11 major categories, of which social and cultural measures constitute category II. Within category II the three main divisions (razdely) are education, health, and social assistance. Each razdel is divided into paragraphs

¹Ezhegodnik BSE-58, p. 63.

²Dostizheniia-57, p. 286; Tsif. -57, p. 366.

³Fed'kin-58, pp. 315-316.

⁴Finansy SSSR, 1958, no. 8, p. 24.

(paragrafy) representing aggregates of similar (odnotipnye) institutions. Finally, paragraphs are divided into articles (stat'i) representing types of expenditures (wages, social insurance charges, office and maintenance expenses, etc.).¹

From the fact that institutional aggregates dominate type-of-expenditure distributions in this scheme, it would appear that distributions of outlays by type of expenditure normally embrace one or more whole groups of similar institutions. Exclusion of part of a group in published statistics (for security or other reasons) would require reaggregating expenditure data for individual institutions-- a possible procedure, but not a routine one.

The groups into which research institutions are classified for budget accounting purposes are not known.² However, the sort of classification followed in Table 4 (combining jurisdictional and branch criteria) would seem expedient for both analytical and operational purposes. Very likely the numerous institutions of the USSR Academy of Sciences constitute a group; budget outlay data (including incomplete type-of-expenditure data) have been published for the Academy as a whole (see Table 13). As was noted earlier, the total disappearance and reappearance of all-Union outlays on medication and bandages in Table 9 argue that health research institutions are treated as a group. Perhaps industrial research institutions are subdivided in budget accounts by branch of industry; if so, the inclusion of one or two branches of industrial research in identified all-Union outlays is not impossible. However, the results of a test described below are consistent with (though they do not prove) the hypothesis that identified outlays cover nonindustrial research only, while unidentified outlays cover all (all-Union) industrial research.

¹Aleksandrov-61, pp. 48-50.

²The classification followed in some other areas of "education" are known: see, for instance, the types of institutions distinguished under general education (16 groups), professional education (13 groups), and culture (5 groups) (Raskhody-58, pp. 13-14, 17, 19). No single criterion of similarity emerges from these examples.

The test involves (1) estimating the distribution by branch of scientists in all-Union research institutions; (2) calculating average budget outlays per scientist in the identified and unidentified aggregates of all-Union outlays (assuming the hypothesis given above); (3) evaluating the plausibility of these averages in the light of what we know about budget outlays per scientist in the Academy of Sciences, in republican research institutions, and in all research institutions in the USSR.

For present purposes, only the distribution of scientists into industrial and nonindustrial branches is relevant: any error within the nonindustrial aggregates is harmless. Therefore the question of reliability is significant only for Rows (1) to (3) of Table 14. Within the USSR columns, the margin of error in these rows is quite small in 1955 and zero in 1960. Distribution of the industry total in Row (2) between all-Union and republican jurisdiction rests upon inferential or incomplete evidence, but the number of misplaced scientists can hardly exceed 10 per cent of the all-Union estimates. Row (3) is derived as a residual (Row (1) less Row (2)); hence Row (1) is the critical one so far as the all-Union and republican estimates are concerned, and the method of estimating this row should be examined in some detail.

In both years, the republican total is obtained by dividing republican budget outlays on science by average outlays per scientist, as estimated from Rows (3b) to (3p) in Table 15. In the case of the RSFSR, Row (3a), division of republican outlays by all research scientists in the republic yields a meaningless figure, since an unusually large proportion of RSFSR scientists are in all-Union institutions.¹ In other republics the proportion is much smaller, and in

¹At the end of 1960 almost half of all research scientists in the USSR were located in Moscow (83.7 thousand or 37.0 per cent of the USSR total) and Leningrad (27.3 thousand or 12.0 per cent): see *Vestnik statistiki*, 1962, no. 4, p. 69. Of the 2,150 research institutions in the RSFSR at the end of 1960 (*NKh-60*, p. 781), those under republican jurisdiction numbered "more than 1,200" (*VAN*, 1961, no. 7, p. 49) or less than 60 per cent.

some it is negligible: for example, 630 of the 637 scientists in Lithuanian research institutions at the end of 1956 were in republican institutions.¹ In eight republics for which data on research scientists in 1956 are available, republican academies of sciences (alone) accounted for almost half of the aggregate total.² Even in the Ukrainian SSR, where academy scientists accounted for only one-fifth of the total in 1955,³ average outlays per scientist in the republic were four times the RSFSR level, which shows that the proportion of all-Union scientists was far smaller than in the RSFSR.

If Row (3b) of Table 15 provides a floor under estimates of outlays per republican scientist, what is the ceiling? Assuming that republican scientists in 1955 accounted for at least two-thirds of all research scientists in the republics represented in Row (3b), the ceiling in that year was about 65 thousand rubles ($43 + 66/100$). The implications of intermediate estimates are illustrated below:

Republican outlays per scientist (1,000 rubles)	Implied republican scientists (1,000)	Total research scientists (1,000)	Implied all-Union scientists (1,000)
50	31	98	67
55	28	98	70
60	26	98	72

Actual outlays per republican scientist in 1955 are arbitrarily taken to be 55 thousand rubles. In 1960, when the floor was 50 thousand rubles, actual outlays are taken to be 60 thousand rubles,⁴ which in

¹See pp. 195-196 of the source to Row (31) of Table 15.

²See Tsif. -57, p. 286, and sources to Table 15. The republics are the Uzbek, Kazakh, Georgian, Latvian, Kirgiz, Armenian, Turkmen, and Lithuanian SSRs, where the number of research scientists on 1 October totalled 10,502 and academy scientists at the end of the year totalled 4,978.

³Estimated from Tsif. -57, p. 286, and Kul't. stroi. -56, p. 253.

⁴These estimates imply that the proportion of republican scientists in the republics represented in Row (3b) of Table 15 rose from 78 per cent in 1955 ($43 + 55$) to 83 per cent in 1960 ($50 + 60$). A trend in this direction, though not necessarily between these two points, seems certain in view of the transfer of institutions from all-Union to republican jurisdiction in the late 1950's.

turn yields estimates of 78 thousand for republican scientists and 122 thousand for all-Union scientists.¹

So far a basic question has been ignored: the representativeness of the 14 republics considered in estimating average outlays per scientist. Their combined outlays on science account for 64 per cent of the republican total in 1955 and 57 per cent in 1960.² If outlays per scientist in the RSFSR were as much as 25 per cent above or below the average for all other republics, the true average would be roughly 10 per cent above or below the average accepted here as representative. As is demonstrated by the tabulation above, raising or lowering republican outlays per scientist by 10 per cent changes the magnitude in which we are really interested (the number of all-Union scientists) by about 5 per cent.

In summary, it seems reasonable to conclude that the estimates of all-Union scientists in Rows (1) to (3) of Table 14 can be read as "plus or minus not more than 10 per cent," which makes them good enough for their intended use here.

Let us now match the estimates of scientists with the appropriate aggregates of budget outlays, and see how outlays per scientist compare. This is done in Table 16. Identified all-Union outlays will be equated with nonindustrial research, and unidentified outlays with industrial research. Strictly speaking, only the 1955 calculation tests the plausibility of these assumptions, since the distribution of all-Union outlays between identified and unidentified in 1960 is estimated.

Before appraising these calculations, let us review the factors which influence the level of budget outlays per scientist. In Soviet conditions it seems safe to assume that prices of labor and other

¹Estimates 5 thousand rubles higher or lower than the accepted figure of 60 thousand would raise or lower the implied figure for all-Union scientists by 6 to 7 thousand.

²Raskhody-58, p. 42; Biudzhety-62, p. 51.

inputs are fairly uniform for all aggregates of research institutions.¹ Hence variations in outlays per scientist at any one point in time may be traced primarily to "real" differences affecting either the numerator or denominator of the outlays/scientists ratio.

The main intrinsic factor affecting the numerator is the relative importance of nonwage outlays, particularly outlays on research materials and investment: the higher these are, other things being equal, the higher outlays per scientist will be. Therefore one may expect outlays per scientist in nonindustrial research (where libraries, laboratories, and computers are the main inputs other than human labor) to be lower than in industrial institutions (where nonlabor costs include not only laboratories and computers but also a succession of experimental models and tests).

An extrinsic factor affecting the numerator is the proportion of research expenditures financed from sources other than the budget allocation to science: the more important these sources are, the lower budget outlays per scientist will be. Since the bulk of the nonbudget outlays on science which we can identify go to industrial research, we may expect budget outlays per industrial scientist to be significantly below total outlays, and thus not directly comparable to ratios in other branches financed to a greater extent by the budget.

The main factor affecting the denominator is the proportion of scientists in total employment: the higher this is, other things being equal, the lower outlays per scientist will be. This explains why outlays per scientist in the USSR Academy of Sciences are below the USSR average (though outlays per employee are above average): scientists account for over one-third of Academy employment (Table 13),

¹Regional wage and price differentials exist, but unless the regional distributions of significant aggregates (all-Union versus republican, industrial versus nonindustrial) differ radically, the generalization is broadly true.

compared with one-sixth in all R&D (Table 7, Col. (8)). The percentage share of scientists in nonindustrial research employment is decidedly higher than in industrial research;¹ this is another reason (in addition to the one advanced above) for expecting outlays per scientist to be lower in nonindustrial than in industrial research.

If the assumptions underlying Table 16 are correct, budget outlays per all-Union industrial scientist in 1955 (Row (6)) were double outlays per nonindustrial scientist (Row (3)). As we have seen, a difference in this direction, though not necessarily of this magnitude, is plausible. Outlays per republican scientist (Row (7)) were on broadly the same level as all-Union nonindustrial research; again this seems plausible, since republican research in 1955 was mainly nonindustrial.

Enterprise-financed outlays in 1955 were 3.3 billion rubles (Table 8, Col. (4)). Assuming that the bulk of these--say, 3 billion--went to all-Union industrial research, total outlays were on the order of 7.5 billion rubles (4.5 + 3), which would boost outlays per scientist to over 200 thousand rubles.

Between 1955 and 1960 budget outlays per all-Union nonindustrial scientist and per republican scientist were roughly stable, while outlays per all-Union industrial scientist more than doubled. Enterprise outlays in 1960 were on the order of 5 billion rubles; assuming that

¹An idea of the difference can be formed from these incomplete and antiquated data (Kul't. stroi. -40, p. 238) for research institutes and branches on 1 January 1939 (scientists as per cent of total employment):

All institutes reporting	24.9
USSR and republican academies	50.8
Agriculture	32.5
Transportation and communications	22.9
Sociology and economics	35.3
Education and art	38.6
Health	20.4
All nonindustrial	27.0
Industry	20.6

If the figure for industry covered not only research institutes but also the design organizations engaged in development, the percentage of scientists would be smaller.

1 to 2 billion went to republican industrial research and the rest to all-Union, all-Union outlays per industrial scientist were on the order of 350 thousand rubles.

Ideally, adjustment should be made not only for enterprise-financed outlays but also for the expenditures which account for the difference between the old and new series for total outlays on research (see Table 8). It is unlikely, however, that the distribution of these outlays (whatever they may be) between industrial and non-industrial uses differs so greatly from the visible pattern as to alter the main conclusion to be drawn from these calculations, which is that outlays per scientist in all-Union industrial research increased by something on the order of 75 per cent (350 + 200) between 1955 and 1960.

Part of this increase may have been due to a decline in the proportion of scientists in industrial research employment.¹ But the larger part must have been due to a radical increase in nonwage outlays.² Since prices of material inputs were generally rather stable from 1 July 1955 through 1960, the increase in nonwage outlays was "real," and is probably explained by a shift toward projects where investment and/or prototype and testing costs are extremely high. The type of evidence considered in this memorandum does not permit us to estimate how much industrial research is addressed to defense problems. There can be little doubt, however, that defense research is concentrated in the industrial category, and must be largely responsible for the shift educed above.

¹ Assuming that outlays per employee remained constant, a decline in the proportion of scientists from, say, 10 to 9 per cent of the total would by itself increase outlays per scientist by about 10 per cent.

² Assuming that the proportion of scientists in total employment remained constant, the increase in the industrial research wage bill between 1955 and 1960 was on the order of 50 per cent (50 + 35, plus a small allowance for increase in the average wage). The increase in total outlays, included enterprise-financed outlays, was from about 7.5 billion rubles to about 17.5 billion, or about 130 per cent. If wage outlays accounted for, say, half of the total in 1955, nonwage outlays increased three-fold between 1955 and 1960.

These inferences remain generally valid even if the association of unidentified all-Union budget outlays with industrial research is erroneous. Let us concede that the only unambiguous clues to trends in all-Union research are total outlays, Academy outlays, and the rough distribution of scientists in the first column of Table 16. The stability of Academy outlays per scientist between 1955 and 1960 argues that nonindustrial outlays per scientist did not increase very much--in other words, that the increase in total outlays on nonindustrial research was close to the increase in nonindustrial scientists (72 + 35, or two-fold). The increase in total all-Union outlays was almost three-fold (18.706 + 6.689). Therefore budget outlays on industrial research probably increased at least three-fold. Since the number of industrial scientists increased by less than one-half (50 + 35), the increase in budget outlays per scientist must have been at least two-fold.

THE HIGH COST OF RESEARCH

The rapid rise in nonwage outlays on research sheds light on growing Soviet sensitivity to research costs. Throughout the 1950's, increasing outlays on science were publicly noted with unqualified pride: the bigger the better, one would suppose. By 1961 the author of a popular article on space research felt obliged to deny that it was extravagantly expensive:¹

Drummers of the 'cold war' slanderously try to assert that Soviet space triumphs have been achieved at the price of unrestrained expenditure of countless sums of money. What nonsense! The engineers, scientists, worker-innovators and inventors of space launching complexes (kosmicheskie verfi) combine flights of imagination with hard calculation, and exhibit great concern for the people's money. In the few years since the first sputnik was launched, the cost of space hardware (kosmicheskie ob"ekty) has declined several times over.

A comment by L. A. Artsemovich, academic secretary of the Department of Physics and Mathematics of the Academy of Sciences, indicates

¹Pravda, 27 August 1961, p. 4.

that the reorganization of science in 1961 was partly motivated by the need to improve allocation of scarce resources among competing research projects:¹

These days scientific investigations are expensive. This is not surprising, since the things which are easy to discover have long been discovered, and we must (figuratively speaking) gouge hard ores from great depths. In these circumstances it is natural that problems of organizing and coordinating scientific research at all levels should assume the highest importance. Up to now our performance in this area has been marked by great weaknesses. One of these is the principle that 'each of the sisters should have a pair of earrings', which operates in the allocation of resources to scientific research. We have been backward in manipulating resources and personnel in order to speed solution of the most urgent research problems.

Explicit acknowledgement that research projects compete not only with each other but with production needs is found in a newspaper article entitled "How much does the experiment cost?":²

The rapid development of science demands ever more specialists, money, and material resources. The construction of a research institute in any branch of chemistry, for example, costs as much as equipping a good plant. We must be concerned not only with scientific results but also with the national resources expended to obtain them... Constant attention to the economics of research will help the state to use its capabilities more fully and increase the effectiveness of research, and thus accelerate the progress of Soviet science.

Though the first quotation should be taken with a grain of salt, it is probably true that Soviet expenditures on space research have been less prodigal than ours. It is also true, however, that we are much richer. The new preoccupation with the economics of research suggests that the Russians are finding it increasingly painful to forego (say) the chemical fertilizer plants needed to increase agricultural output, in order to sustain the momentum of a large and irreducibly expensive research program.

¹VAN, 1961, no. 7, p. 41.

²S. Batsanov, Doctor of Chemistry, in Izvestia, 11 October 1962, p. 3.

Table 1
DISTRIBUTION OF SCIENTISTS (NAUCHNYE RABOTNIKI) BY
DISCIPLINE, 1 OCTOBER, 1955 AND 1960

	1955		1960		Increase (per cent)
	(units)	(per cent)	(units)	(per cent)	
TOTAL	223,893	100.0	354,158	100.0	58
Technical sciences	61,107	27.3	129,843	36.7	112
Medicine and pharmacy	25,326	11.3	32,174	9.1	27
Physics, mathematics	20,077	9.0	28,966	8.2	44
Chemistry	16,435	7.4	26,237	7.4	60
Agriculture, veterinary medicine	15,135	6.8	21,186	6.0	40
Biology	11,009	4.9	15,091	4.2	37
Geology, mineralogy	5,653	2.5	10,671	3.0	89
Geography	3,381	1.5	4,274	1.2	26
Subtotal: Physical and biological sciences	158,123	70.6	268,442	75.8	70
Philology	17,743	7.9	21,234	6.0	20
History, philosophy	15,305	6.8	19,831	5.6	30
Education	11,478	5.1	14,093	4.0	23
Economics	8,247	3.7	13,884	3.9	68
Art	4,000	1.8	5,614	1.6	40
Law	1,607	0.7	2,249	0.6	40
Architecture	876	0.4	1,438	0.4	64
Unspecified	6,514	2.9	7,373	2.1	13
Subtotal: Social sciences, humanities, and unspecified	65,770	29.4	85,716	24.2	30

Sources:

1955: Kul't. stroi. -56, p. 250.
1960: NKCh-60, p. 784.

Table 2

DATA RELATING TO THE SCALE OF SCIENTIFIC RESEARCH, 1928-1961

	1928	1940	1945	1950	1955	1956	1957	1958	1959	1960	1961
SCIENTISTS, 1 October (1,000)											
In scientific institutions	x	26.4	59.3 ^e	70.5	96.5	106.4	121.5	141.0	164.8	200.1	238.5
In higher educational institutions	x	61.4	81.5 ^e	86.5	119.1	125.0	132.3	135.7	137.8	146.9	158.4
In administrative and economic organizations	x	10.5	4.8 ^e	5.5	8.3	8.5	7.8	7.3	7.4	7.2	7.2
Total	x	98.3	145.6 ^e	162.5	223.9	239.9	261.6	284.0	310.0	354.2	404.1
RESEARCH INSTITUTIONS, end of year											
Research institutes ^a	438	786	914	1,157	1,210	1,264	1,340	1,482	1,608	1,729	x
Scientific stations ^b	120	507	415	571	574	x	x	477	485	494	x
Other ^c	705	528	732	1,120	1,013	x	x	1,238	1,455	1,605	x
Total	1,263	1,821	2,061	2,848	2,797	2,756	2,983	3,197	3,548	3,828	x
TOTAL EMPLOYMENT IN "SCIENCE AND SCIENTIFIC SERVICES," annual average (1,000)^d											
Geological survey organizations	10	70	x	245	356	379	382	398 ^f	(414)	(431)	(448)
Weather and hydrological service	8	24	x	32	42	42	45	47 ^f	(49)	(51)	(53)
Other (inferred to be R&D)	64	267	x	437	594	673	781	881 ^f	(1,011)	(1,281)	(1,525)
Total	82	361	x	714	992	1,094	1,208	1,338	1,474	1,763	2,026

Notes:

- x Not available.
() Provisional estimate.

(continued)

Table 2 (continued)

^aIncluding branches and affiliates.

^bPrimarily agricultural (see Table 4).

^cFor types of institutions in this category, see Table 3.

^dThe data include non-scientists (e.g., engineers, technicians, clerical, and other workers) and exclude scientists employed in areas of the national economy other than "science and scientific services" (e.g., higher education, health, industry).

^e1947.

^fPreliminary data.

Sources:

Scientists

1940, 1955, 1958-1960: NKh-60, p. 782.

1947 (in 1945 column), 1961: Tsif. -61, p. 332.

1950, 1956-1957: NKh-58, p. 843.

Scientific Institutions

1928-1955: Kul't. stroi. -56, p. 244.

1956-1958: NKh-58, p. 842.

1959: NKh-59, p. 753.

1960: NKh-60, p. 781.

Total Employment in "Science and Scientific Services"

1928, 1940, 1950-1958 (except 1958 total): NKh-58, p. 659.

1958-1960 (totals): NKh-60, p. 637.

1961 (total): Tsif. -61, p. 312.

1959-1961 (components): Employment in geological survey organizations and the weather and hydrological service is assumed to increase by 4 per cent a year. Employment in "Other" organizations (including research institutions) is derived as a residual.

Table 3
DISTRIBUTION OF RESEARCH INSTITUTIONS BY TYPE, 1955 (END OF YEAR)

	Institutions	Scientists employed	
		Total (1,000)	Average per institution
TOTAL	2,797	97.8	35
Research institutes	1,064	73.5	69
Branches of institutes	146	3.8	26
Scientific stations ^a	574	6.2	11
Testing and experimental fields and bases ^a	184	0.6	3
Laboratories	142	2.6	18
Observatories	38	0.7	18
Conservation agencies	74	0.7	9
Committees and subsections of academies of sciences	60	2.1	35
Museums ^b	392	3.5	9
Libraries ^b	61	2.0	33
Other	62	2.1	34

Notes:

^a Mostly agricultural (see Table 4, and SKh-60, p. 15).

^b Only those with research activities.

Source:

Kul't. stroi. -56, p. 245. For a similar distribution for the RSFSR (only) in 1956, see TsSU RSFSR, Kul'turnoe stroitel'stvo RSFSR, Moscow, 1958, p. 388.

Table 4
DISTRIBUTION OF RESEARCH INSTITUTES AND STATIONS BY JURISDICTION,
1955 (END OF YEAR)

	Institutes ^a		Scientific Stations	
	Number	Scientists employed	Number	Scientists employed
TOTAL	1,210	77,349	574	6,182
USSR Academy of Sciences ^b	93	11,447	19	197
Republican academies of sciences	229	7,213	33	273
Ministries and economic bodies ^c	888	58,689	522	5,712
(Grouped by branch):				
Industry	368	35,132	27	282
Construction	38	2,443	3	36
Transport and communications	19	2,754	2	11
Agriculture	122	4,361	466	5,151
Health	231	9,884	3	34
Education ^d	55	1,609	17	107
Culture and fine arts	8	567	-	-
Other	47	1,939	4	91

Notes:

^aIncluding branches and affiliates.

^bA partial listing of the 87 research institutes under the USSR Academy of Sciences at the end of 1955 is given in Ezhegodnik BSE-57, pp. 69-70. The 60 mentioned were distributed by branch (otdelenie) as follows: mathematics and physics, 11; chemistry, 10; geology and geography, 7; biology, 12; technical sciences, 10; history, 4; economics, philosophy, and law, 3; literature and language, 3.

^cIncluding the specialized academies of sciences. Institutes under the four all-Union specialized academies (agriculture, construction and architecture, medicine, fine arts) are listed in ibid., pp. 71-73. Specialized academies also exist at the republican level: e.g., the RSFSR has academies of pedagogical sciences and of municipal economy, and six other republics have established academies of agricultural sciences since 1957.

Table 4 (continued)

^dProsveshchenie. Inferred to include: (1) the 15 to 20 pedagogical research institutes controlled by republican ministries of education and the RSFSR Academy of Pedagogical Sciences (BSE, 2d ed., v. 32, p. 274, and Ezhegodnik BSE-57, p. 174); (2) research institutes in various disciplines at colleges and universities directly administered by the Ministry of Higher Education. The latter were demonstrably included in statistics of research institutions in the 1930's (see TsUNKhU, Sotsialisticheskoe stroitel'stvo SSSR, Moscow, 1936, p. 591).

Source:

Kul't. stroi. -56, p. 245.

Table 5
RESEARCH INSTITUTIONS AND SCIENTISTS EMPLOYED, 1956 AND 1960

	1956			1960			Increase	
	Institutions ^a	Total	Scientists ^b Average per institution	Institutions ^a	Total	Scientists ^b Average per institution	Institutions (per cent)	Scientists
USSR TOTAL	2,756	106,400 ^c	>39	3,828	200,100 ^c	>52	39	88
Academies of sciences	738	32,150	44	1,108	62,905	57	50	96
General academies	490	24,389	50	630	42,828	68	29	76
USSR Academy of Sciences	195	15,716	81	241	23,771	99	24	51
Republican academies	295	8,673	29	389	19,057	49	32	120
Specialized academies	248	7,761	31	478	20,077	42	93	159
Construction and architecture	30	1,225	41	56	4,971	89	87	306
Agriculture	171	3,719	22	364	11,224	31	113	202
Medicine	27	1,910	71	32	2,794	87	19	46
Pedagogy	12	504	42	18	635	35	50	26
Fine arts	4	103	26	4	91	23	-	(-)12
Communal economy	4	300	75	4	362	90	-	21
All other research institutions	2,018	>74,250	>37	2,720	>137,195	>50	35	>85
Controlled by industrial bodies	x	x	x	x	74,000 ^c	x	x	x
Of which: Regional economic councils	-	-	-	x	22,000 ^c	x	x	x
Other	x	x	x	x	>63,000	x	x	x

Notes:

- Zero.
x Not available.

^aEnd of year.

^bEnd of year, except where otherwise specified.

^c1 October.

Sources:

USSR totals from Table 2. Academies from Dostizhenila-57, p. 286, and MCh-60, p. 787. "All other research institutions" derived as a residual. Scientists in research institutions controlled by industrial bodies (including regional economic councils) on 1 October 1960 derived from their shares in the USSR total (37 and 11 per cent, respectively: *Vestnik statistiki*, 1962 no. 4, p. 67).

Table 6

ADMINISTRATORS AND SPECIALISTS IN SCIENTIFIC AND RESEARCH
INSTITUTIONS, AND IN PROJECT, DESIGN, AND GEOLOGICAL
SURVEY ORGANIZATIONS, 1 JANUARY, 1941 AND 1957
(in thousands)

	1941	1955
1. Scientific and Research Institutions	78	246
Administrators of institutions; ^a learned secretaries; chief specialists	x	9
Administrators of structural subdivisions of institutions	x	20
Administrators of affiliates	x	1
Administrators of experimental plants and production complexes, of experimental shops, workshops, shifts	x	3
Administrators of research parties, expeditions, detachments	x	1
Scientists (<u>nauchnye sotrudniki</u>) ^b	x	58
Engineers	x	50
Technicians	x	45
Laboratory workers	x	36
Chief and senior bookkeepers	x	5
Unspecified residual	x	18
2. Project Organizations	68	167 ^c
3. Design Organizations	x	92 ^c
4. Both Project and Design Organizations	x	261 ^c
Administrators of organizations; chief engineers and chief specialists	x	19
Administrators of structural subdivisions of organizations	x	32
Engineers	x	116
Technicians	x	75
Chief and senior bookkeepers	x	3
Engineer-economists, economists, planners	x	4
Unspecified residual	x	12
5. Geological Survey Organizations	x	74
6. TOTAL (sum of Rows 1, 4, and 5)	x	581 ^d

Notes:

x Not available.

^aHere and in the rows following, "administrators" means directors and assistant directors (rukovoditeli, zamestiteli rukovoditelei).

Table 6 (continued)

^bThe category probably refers to scientists in positions carrying the de facto rank of starshii or mladshii nauchnyi sotrudnik (see p. 5, footnote 1).

^cThe discrepancy between the figures for project and design organizations individually and in the aggregate is due to rounding of the percentage data which entered into their computation.

^dIncluding about 130 thousand "practicals" (persons occupying positions for which they lack the formal educational qualifications). The figure for persons with higher and specialized secondary education is given in Table 7, Col. (7).

Sources:

Computed from numbers of women specialists (rounded to the nearest 100) and their percentage shares (rounded to the nearest percentage point) in the USSR total, as given in TsSU, Zhenshchina v SSSR, Moscow, 1960, pp. 45-46, 54-55.

Table 7
TOTAL AND SPECIALIST EMPLOYMENT IN RESEARCH INSTITUTIONS AND IN PROJECT,
DESIGN, AND GEOLOGICAL SURVEY ORGANIZATIONS, 1940, 1956, 1959-1960
(in thousands)

	Research inst. (1)	Geol. surv. orgs. (2)	Col.(1)+ Col.(2) (3)	Project orgs. (4)	Design orgs. (5)	Col.(4)+ Col.(5) (6)	Col.(3)+ Col.(6) (7)	Col.(1)+ Col.(5) (8)
1940								
Total employment ^a	(150)	70	(220)	(110)	(117)	(227)	(447)	270
"Administrators and specialists" ^b	78	x	x	68	x	x	x	x
Specialists ^c	(53)	(10)	(63)	(40)	(20)	(60)	123	(70)
Higher education	x	x	(51)	x	x	(40)	90	x
Specialized secondary education	x	x	(12)	x	x	(20)	32	x
Scientists ^d	26	...	26	...	...	...	26	30
1956								
Total employment ^a	(321)	379	(700)	251	(352)	(603)	1,303	670
"Administrators and specialists" ^b	246	74	320	167	92	261	581	340
Specialists ^c	(195)	(59)	254	(125)	(70)	195	449	(260)
Higher education	(128)	(39)	167	(79)	(45)	124	291	(170)
Specialized secondary education	(67)	(20)	87	(46)	(25)	71	158	(90)
Scientists ^d	106	...	106	...	...	...	106	110
1959								
Total employment ^a	(511)	(414)	(925)	303	500	803	1,728	1,010
Specialists ^c	(315)	(74)	389	(160)	(142)	302	691	(460)
Higher education	(211)	(50)	261	(100)	(88)	188	449	(300)
Specialized secondary education	(103)	(24)	127	(60)	(54)	115	242	(160)
Scientists ^d	165	...	165	...	...	...	165	170
1960								
Total employment ^a	(644)	(431)	(1,075)	346	(637)	(983)	2,058	1,280
Specialists ^c	(390)	(75)	465	(185)	(193)	378	843	(580)
Higher education	(260)	(50)	310	(115)	(117)	232	542	(380)
Specialized secondary education	(130)	(25)	155	(70)	(76)	146	301	(200)
Scientists ^d	200	...	200	...	...	...	200	200

Notes:

... Zero or negligible.

x Not available and not estimated.

() Provisional estimate.

^aAnnual average.^bIncluding "practicals". Data refer to end of year.^cExcluding "practicals". Data for 1940 refer to end of year, data for other years refer to 1 December.^dData refer to 1 October.^eRounded to the nearest 10 thousand.

(continued)

Sources to Table 7 (figures not in parentheses)

Col. (1)

"Administrators and specialists" from Table 6. Scientists from Table 2.

Col. (2)

Total employment from Table 2.

"Administrators and specialists" from Table 6.

Col. (3)

Specialists (total and components) derived by subtracting Col. (6) from Col. (7).

Col. (4)

Total employment from Kap. stroi. -61, p. 268. "Administrators and specialists" from Table 6.

Col. (5)

Total employment in 1959 explained in text. "Administrators and specialists" from Table 6.

Col. (6)

Specialists (total and components) from Kap. stroi. -61, p. 268.

Col. (7)

Total employment is equal to employment in "Science and scientific services" (Table 2) less employment in the weather and hydrological service (ibid.) plus employment in project organizations (Col. 4).

Specialists (total and components) from NKh-60, p. 651; Dosti-zheniia-57, p. 260; NKh-59, p. 605.

Col. (8)

Total employment from Table 2 ("Other" scientific employment).

Table 8
OUTLAYS ON SCIENTIFIC RESEARCH, 1928-1962 PLAN
(billion current pre-1961 rubles)

Year ^a	"TOTAL" OUTLAYS ^b		Budget outlays on "science" (3)	Outlays by economic bodies (enterprises, ministries, sovmarkhozy)	
	New series (1)	Old series (2)		Research (4)	Investment (5)
1928/29	x	x	0.090	x	x
1929/30	x	x	0.185	x	x
1931	x	x	0.243	x	x
1932	x	x	0.308	x	x
1928-1932 total	x	1.490	0.877	0.613	0.095
1933	x	x	0.324	x	x
1934	x	x	0.435	x	x
1935	x	x	0.637	x	x
1936	x	x	0.766	x	x
1937	x	x	0.852	x	x
1933-1937 total	x	5.055	3.015	2.040	0.303
1938	x	(1.5)	(0.9)	(0.6)	(0.06)
1939 plan	x	x	0.903	x	x
actual	x	(1.6)	(1.0)	(0.6)	(0.06)
1940 plan	x	x	0.938	x	x
actual	x	(1.7)	1.135	(0.6)	(0.05)
1938-1940 total	x	(4.9)	3.084	(1.8)	(0.17)
1941 plan	x	1.651	1.032	0.619	x
actual	x	(2.1)	(1.4)	(0.7)	(0.03)
1942	x	(2.0)	(1.3)	(0.7)	(0.03)
1941-1942 total	x	(4.1)	2.734	(1.4)	(0.06)
1943	x	1.818	1.079 ^c	0.739	0.040
1944 plan	x	1.3 ^c	0.813 ^c	0.5 ^c	x
actual	x	2.464	1.551	0.913	0.050
1945 plan	x	x	(2.3)	x	x
actual	x	2.978	2.127	0.851	0.050

1928-1945 total	x	22.867	14.467	8.400	0.768
1946 plan	x	6.389	5.062	1.327	x
actual	x	(6)	4.4	(1.5)	x
1947 plan	x	x	(5.9)	x	x
actual	x	(8.5)	(6)	(2.5)	x
1948	x	(8.5)	(6)	(2.5)	x
1949 plan	x	9.1	6.6	2.5	x
actual	x	(9)	(6.6)	(2.5)	x
1946-1949 total	x	(32)	23	(9)	x
1950 plan	x	8.1	5.6	2.5	x
actual	9.01	7.9	5.388	2.5	x
1946-1950 total	x	(40)	28	(11.5)	x
1951 plan	x	8.0	5.3	2.7	x
actual	x	(8)	5.434	(2.7)	x
1946-1951 total	x	47.2	33	14	x
1952	x	(8.6)	5.627	(3.0)	x
1953	11.3	(9.2)	6.244	(3.0)	x
1954 plan	x	9.5	x	x	x
actual	x	(9.8)	6.850	(3.0)	x
1955	x	11.5	8.247	3.3	x
1956 plan	x	13.6	x	x	x
actual	17.3	(13.3)	10.297	(3.0)	x
1957 plan	x	x	11.7	x	x
actual	x	16.4	13.588	2.8	x
1958 plan	x	18.2	15.0	3.2	x
actual	24.19	(20.2)	16.958	(3.2)	x
1959 plan	27.3	x	23.1 ^d	4.2	x
actual	28.15	(24.2)	20.043	(4.2)	x
1960 plan	32.6	x	x	x	x
actual	32.93	x	23.389	x	x
1961 plan	38	x	x	x	x
actual	(38)	x	(27-28)	x	x
1962 plan	43	x	x	x	x

Notes:

- x Not available.
- () Provisional estimate.

(continued)

Table 8 (continued)

^aData for years not otherwise specified refer to actual outlays. Split-year data refer to a fiscal year running from October through September; from 1931 on, the fiscal and calendar years coincided.

^bThe old series in Col. (2) is manifestly incomplete: it is the sum of Cols. (3) and (4), and therefore excludes Col. (5) as well as any other budget outlays not designated to science (such as outlays from funds budgeted to higher educational institutions). The scope of Col. (1) is not clear (see text).

^cData apparently have a narrower coverage than adjacent rows. The nature of the exclusion is not known.

^dThe figure has a broader coverage than adjacent rows. Apparently it includes budget outlays not ordinarily designated to science.

Sources:

Col. (1)

1950, 1958-1960 (actual): NKh-60, p. 848.
1953, 1956 actual: NKh-59, p. 805.
1959 plan: Zverev in Pravda, 23 December 1958.
1960 plan: Garbuzov in Izvestiia, 28 October 1959.
1961 plan: Garbuzov in Izvestiia, 21 December 1960.
1961 actual, 1962 plan: Planned outlays of 43 bil.r. in 1962 described as 12 per cent over 1961 (Garbuzov in Izvestiia, 7 December 1961).

Col. (2)

Note: Data not otherwise identified are derived as the sum of Cols. (3) and (4).

1928-1932 total, 1933-1937 total, 1943-1945, 1928-1945 total: Plotnikov-48, p. 334.
1941 plan: Zverev-46, p. 111.
1944 plan: Ibid., p. 135.
1950 plan: Zverev in PKh, 1950 no. 4, p. 13.
1951 plan: Zverev in Zasedaniia-51, p. 31.
1946-1951 total: Plotnikov-54, p. 426.
1954 plan: Zverev in Zasedaniia Verkhovnogo soveta SSSR..., 20-27 aprelia 1954 g., Moscow, 1954, p. 42.
1955, 1956 plan: Plotnikov in Finansy SSSR, 1956 no. 2, p. 27.
1957 actual, 1958 plan: According to Zverev in Pravda, 20 December 1957, planned 1958 outlays of 18.2 bil.r. were 1.8 bil.r. over 1957.

Col. (3)

1928/29-1932: Plotnikov-48, p. 78.
1928-1932 total, 1933-1937 total, 1943-1945, 1928-1945 total: Ibid., p. 334.
1933-1937: Narodnyi komissariat finansov, Gosudarstvennyi biudzheth Soiuza SSR za vtoruiu piatiletku (1933-1937 gg.), Moscow, 1939, p. 9.

1938-1939 actual: Interpolated, given the total for 1938-1940 and the figure for 1940.
1939 plan: Zverev-46, p. 47.
1940 plan, 1941 plan: Ibid., p. 111.
1940, 1950-1957 (actual): Raskhody-58, p. 10.
1938-1940 total, 1946 actual: Nar. obraz. -57, p. 780.
1941-1942: Interpolated, given the total for these years.
1941-1942 total: Derived by subtraction, given the total for 1928-1945 and the figures for years other than 1941-1942.
1944 plan: Zverev-46, p. 135.
1945 plan: Implied by the statement in ibid., p. 156, that outlays would be 50 per cent above 1944.
1946 plan: Zverev in Zasedaniia-46, p. 21.
1947 plan: Implied by Zverev's statement in Zasedaniia Verkhovnogo soveta SSSR..., 20-25 fevralia 1947 g., Moscow, 1947, p. 29, that budget outlays would be 1.5 bil.r. over 1946.
1947 actual, 1949 actual: Assumed equal to plan.
1948: Derived by subtraction, given the total for 1946-1949 and the figures for years other than 1948.
1949 plan: Zverev in PKh, 1949 no. 2, p. 49.
1946-1949 total: Derived by subtraction, given the total for 1946-1950 and the figure for 1950.
1950 plan: According to Zverev (PKh, 1950 no. 4, p. 13), budget outlays were planned at 5.4 bil.r., (current) outlays of economic enterprises at 2.5 bil.r., and total outlays at 8.1 bil.r. (which leaves 0.2 bil.r. unaccounted for). According to Plotnikov-54, p. 426, budget and enterprise outlays were respectively 5.6 and 2.5 bil.r.; his data are inferred to refer to plan, since the figure for budget outlays is above the official actual figure, and since his implied total (8.1 bil.r.) agrees with Zverev's planned total.
1946-1950 total: Lavrov in Finansy i sotsialisticheskoe stroitel'stvo, Moscow, 1957, p. 208.
1951 plan: Zverev in Zasedaniia-51, p. 31.
1946-1951 total: Sum of figures for 1946-1950 total and 1951.
1957 plan, 1958 plan: Zverev in Izvestiia, 20 December 1957.
1958-1960 (actual): Biudzhety-62, p. 51.
1959 plan: Zverev in Pravda, 23 December 1958.
1961: Extrapolated.

Col. (4)

1928-1932 total, 1933-1937 total, 1943-1945, 1928-1945 total: Plotnikov-48, p. 334.
1938-1940 total, 1941-1942 total, 1946-1949 total, 1946-1950 total: Sum of estimates for individual years.
1938-1942 (actual): Interpolated. The total for these years was 3.2 bil.r. (derived by subtraction, given the 1928-1945 total and the figures for years other than 1938-1942).
1941 plan: Zverev-46, p. 111.
1944 plan: Ibid., p. 135.
1946 plan: Zverev in Zasedaniia-46, p. 21.
1946-1949, 1951: Interpolated. The total for these years was around 11.5 bil.r. (derived by subtraction, given the figures for 1946-1951 total and for 1950).

1949 plan: Zverev in PKh, 1949 no. 2, p. 49.
1950 plan: Zverev in PKh, 1950 no. 4, p. 13.
1950 actual: Nar. obraz. -57, p. 781.
1951 plan: Zverev in Zasedaniia-51, p. 31.
1946-1951 total: Derived by subtraction--Col. (2) less Col. (3).
1952-1954, 1956 (actual): Interpolated, given 1951 plan as 2.7
bil.r., 1955 actual as 3.3 bil.r., and 1957 actual as 2.8 bil.r.
1955, 1957 (actual), 1958 plan: Derived by subtraction--Col. (2)
less Col. (3).
1958-1959 (actual): Assumed equal to plan.
1959 plan: Zverev in Pravda, 23 December 1958.

Col. (5)

1928-1932 total, 1933-1937 total, 1943-1945, 1928-1945 total:
Plotnikov-48, p. 334.
1938-1942: Interpolated. The total for these years was 0.230 bil.r.
(derived by subtraction, given the 1928-1945 total and the figures
for years other than 1938-1942).
1938-1940 total, 1941-1942 total: Sum of estimates for individual
years.

Table 9

IDENTIFIED AND UNIDENTIFIED BUDGET OUTLAYS ON SCIENTIFIC RESEARCH, 1940, 1950-1961
(billion pre-1961 rubles, unless otherwise specified)

	1940	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
(1) Total outlays (consolidated government budget)	1.135	5.388	5.434	5.627	6.244	6.850	8.247	10.297	13.588	16.958	20.043	23.389	(27-28)
(2) Republican budgets, total	0.616	1.352	1.334	1.281	1.349	1.476	1.558	1.876	2.707	3.659	4.489	4.683	(5)
(3) Identified outlays, total	x	1.327	1.310	1.258	1.334	1.460	1.539	1.855	2.607	3.593	4.401	4.365	x
(4) Wages ^a	x	0.748	0.757	0.739	0.765	0.835	0.867	1.024	1.312	1.651	1.869	1.711	x
(5) Social insurance	x	0.035	0.035	0.034	0.036	0.041	0.042	0.050	0.068	0.092	0.105	0.094	x
(6) Travel allowances	x	0.008	0.009	0.008	0.007	0.008	0.008	0.009	0.014	0.017	0.019	0.018	x
(7) Stipends to students	x	0.021	0.023	0.024	0.026	0.032	0.036	0.038	0.042	0.043	0.051	0.060	x
(8) Meals	x	0.064	0.054	0.045	0.046	0.046	0.048	0.050	0.054	0.056	0.059	0.060	x
(9) Office and maintenance expenses ^b	x	0.103	0.102	0.099	0.102	0.106	0.112	0.127	0.153	0.185	0.211	0.202	x
(10) Instructional and research expenses ^c	x	0.146	0.152	0.143	0.149	0.163	0.183	0.225	0.404	0.595	0.716	0.757	x
(11) Purchased medication and bandages	x	0.013	0.013	0.012	0.021	0.020	0.022	0.023	0.025	0.028	0.030	0.032	x
(12) Purchased special clothing and bedding	x	0.010	0.010	0.010	0.013	0.010	0.011	0.013	0.013	0.014	0.018	0.023	x
(13) Capital investment in equipment ^d	x	0.077	0.058	0.048	0.057	0.067	0.076	0.116	0.189	0.247	0.306	0.322	x
(14) Capital investment in construction ^e	x	0.046	0.037	0.038	0.049	0.065	0.059	0.095	0.210	0.509	0.839	0.902	x
(15) Capital repair of buildings and equipment	x	0.056	0.060	0.059	0.062	0.069	0.075	0.085	0.122	0.156	0.178	0.184	x
(16) Unidentified outlays ^f	x	0.025	0.024	0.023	0.015	0.015	0.019	0.021	0.100	0.066	0.088	0.318	x
(17) Per cent of Row (2)	x	1.8	1.8	1.8	1.1	1.0	1.2	1.1	3.7	1.8	2.0	6.8	x
(18) All-Union budget, total	0.519	4.036	4.099	4.346	4.894	5.374	6.689	8.421	10.881	13.299	15.554	18.706	(22-23)
(19) Identified outlays, total	x	1.765	1.594	1.872	1.794	1.988	2.223	2.484	2.766	(3.3)	(3.9)	(4.7)	(6)
(20) Wages ^a	x	0.912	0.888	1.006	0.978	1.040	1.164	1.243	1.308	x	x	x	x
(21) Social insurance	x	0.044	0.041	0.048	0.044	0.051	0.058	0.063	0.066	x	x	x	x
(22) Travel allowances	x	0.005	0.004	0.005	0.005	0.005	0.005	0.005	0.005	x	x	x	x
(23) Stipends to students	x	0.031	0.026	0.030	0.030	0.031	0.034	0.034	0.035	x	x	x	x
(24) Meals	x	0.026	0.022	0.018	0.017	0.018	0.020	0.020	0.021	x	x	x	x
(25) Office and maintenance expenses ^b	x	0.096	0.091	0.102	0.099	0.104	0.110	0.112	0.112	x	x	x	x
(26) Instructional and research expenses ^c	x	0.333	0.288	0.340	0.307	0.347	0.436	0.530	0.601	x	x	x	x
(27) Purchased medication and bandages	x	0.004	-	0.005	0.006	0.005	0.006	0.005	0.005	x	x	x	x
(28) Purchased special clothing and bedding	x	0.005	0.006	0.007	0.010	0.007	0.008	0.008	0.009	x	x	x	x
(29) Capital investment in equipment ^d	x	0.140	0.092	0.104	0.124	0.172	0.185	0.202	0.270	x	x	x	x
(30) Capital investment in construction ^e	x	0.140	0.107	0.176	0.137	0.178	0.167	0.227	0.302	x	x	x	x
(31) Capital repair of buildings and equipment	x	0.030	0.026	0.032	0.036	0.030	0.031	0.036	0.032	x	x	x	x
(32) Unidentified outlays	x	2.271	2.505	2.474	3.101	3.386	4.466	5.937	8.115	(10.0)	(11.7)	(14.0)	(16-17)
(33) Per cent of Row (18)	x	56	61	57	63	63	67	70	75	75	75	75	73-74
(34) Per cent of Row (1)	x	42	46	44	50	49	54	58	60	59	58	60	59-61

Notes:

x Not available.

- Zero.

() Provisional estimate.

Minor discrepancies between totals and components are due to rounding.

(continued)

Notes to Table 9 (continued)

^aWages and supplementary payments to regular staff (shtatnye rabotniki). Excludes wages of workers hired temporarily for maintenance or repair jobs (see V. Menchinskii, Sostavlenie i ispolnenie smety biudzhethnogo uchrezhdeniia, Moscow, 1955, p. 12).

^bOffice materials; telephone and postal expenses; rent; heat, water, and power (except for research purposes); janitorial services; maintenance of transport; quarters and services provided free to staff (ibid., pp. 17-18).

^cMaterials and equipment used in teaching and student laboratory work; expenses of scientific meetings and expeditions; materials and utensils used in research (e.g., chemicals, glassware, drafting materials, metals, seeds); payment for experimental and testing work performed by outside organizations; payment for services of experimental shops within the organization; preparation of experimental models, blueprints, and mock-ups; publication of research studies; purchase of books for libraries (ibid., pp. 24-25).

^dOffice and laboratory furniture; machinery, instruments and apparatus. Excludes items valued at less than 20 rubles, and anything with a service life of less than one year, regardless of value; such items are classed as either "office and maintenance" or "instructional and research" expenses (ibid., pp. 29-30).

^eExcluding investment from funds budgeted to economic bodies (see Raskhody-58, p. 46, note).

^fPresumably consisting of the following types of expenditures (designated prochie raskhody in the classification of outlays of budget-supported institutions): cultural and recreational measures; maintenance of kindergartens and nurseries; allowances to widows of academicians (Menchinskii, op. cit., p. 33).

Sources:

Row (1)

All years: Table 8, Col. (3).

Rows (2), (18)

1940-1957: Raskhody-58, p. 42.
1958-1960: Biudzhety-62, p. 51.
1961: Extrapolated.

Row (3)

1940-1960: Sum of sub-items.
1961: Extrapolated.

Rows (4)-(15)

1940-1957: Raskhody-58, p. 60.
1958-1960: Biudzhety-62, p. 86.

Sources to Table 9 (continued)

Row (16)

1940-1960: Row (2) less Row (3).

Row (19)

1940-1957: Sum of sub-items.

1958-1961: Extrapolated.

Rows (20)-(31)

1940-1957: Consolidated budget outlays (Raskhody-58, p. 59)
less republican budget outlays.

Row (32)

All years: Row (18) less Row (19).

Table 10

AREAS OF ALL-UNION AND REPUBLICAN JURISDICTION^a

	All-Union	All-Union and Republican	Republican
	(1)	(2)	(3)
<u>Nonindustrial:</u>	Ocean transport Railroads Foreign trade Foreign affairs ^b Defense ^b	Geology and mi- neral resources Agriculture Finance Communications Higher and spe- cialized secondary education Health Culture Internal affairs	Automobile transport Water resources Communal economy Education River fleet Social assistance Trade Grain products Justice
<u>Industry and construction:</u>	Medium machine building ^c Transport construc- tion Electric power con- struction	(All other industry and construction) ^d	

Notes:

^aAreas of jurisdiction are equated with ministries. Data refer to 1961, but the general pattern is characteristic of all years since industrial reorganization in 1957.

^bNominally these ministries exist on both the all-Union and republican levels (Ananov-60, p. 79). However, though several republics have ministers of foreign affairs, while at least the RSFSR had a defense ministry as of 1 October 1959 (ibid., p. 114), republican authority in these areas appears to be limited if not entirely fictitious.

^cCommonly believed to administer the nuclear energy program.

^dSpecialized all-Union committees monitor and coordinate the following branches: aviation technology, automation and machine building, defense technology, shipbuilding, radioelectronics, electronic technology, chemistry, and construction. All-Union authority in other branches is concentrated in the USSR State Planning Committee. In the republics, authority is exercised by republican planning committees, ministries (construction only), and regional economic councils.

Sources:

Ananov-60, pp. 79, 111, 114; Ezhegodnik BSE-61, p. 8.

Table 11

PERCENTAGE DISTRIBUTION OF IDENTIFIED BUDGET
OUTLAYS ON SCIENTIFIC RESEARCH

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960
Republican Budgets											
(1) Total identified outlays	100	100	100	100	100	100	100	100	100	100	100
(2) Operating outlays ^a	86	88	88	87	86	86	84	80	75	70	68
(3) Capital outlays ^b	14	12	12	13	14	14	16	20	25	30	32
(4) Total operating outlays ^a	100	100	100	100	100	100	100	100	100	100	100
(5) Wages	65	66	66	66	66	65	66	63	62	61	58
(6) Instruction and research	13	13	13	13	13	14	14	19	22	23	26
(7) Other	22	21	21	21	21	21	20	18	16	16	16
All-Union Budget											
(8) Total identified outlays	100	100	100	100	100	100	100	100	x	x	x
(9) Operating outlays ^c	82	86	83	83	81	83	81	78	x	x	x
(10) Capital outlays ^d	18	14	17	17	19	17	19	22	x	x	x
(11) Total operating outlays ^c	100	100	100	100	100	100	100	100	x	x	x
(12) Wages	63	65	64	65	65	63	62	60	x	x	x
(13) Instruction and research	23	21	22	20	22	24	26	28	x	x	x
(14) Other	14	14	14	15	13	13	12	12	x	x	x

Notes:

x Not available.

^aSum of Rows (4) through (12) in source.^bSum of Rows (13) through (15) in source.^cSum of Rows (20) through (28) in source.^dSum of Rows (29) through (31) in source.Source:

Table 9.

Table 12

INDEXES OF REPUBLICAN AND ALL-UNION OUTLAYS
ON SCIENTIFIC RESEARCH, 1951-1960

(previous year = 100)

	1951	1952	1953	1953	1955	1956	1957	1958	1959	1960
<u>Republican Budgets</u>										
(1) <u>Total identified outlays</u>	99	96	105	109	106	120	144	135	123	104
(2) <u>Operating outlays^a</u>	101	96	105	108	106	117	134	129	115	96
(3) <u>Wages</u>	101	98	104	109	104	118	128	126	113	92
(4) <u>Instruction and research</u>	104	94	104	109	112	123	180	147	120	106
(5) <u>Other</u>	97	94	109	104	107	111	119	118	113	99
(6) <u>Capital outlays^b</u>	87	94	116	120	104	141	176	175	145	106
<u>All-Union Budget</u>										
(7) <u>Total identified outlays</u>	90	117	96	111	112	112	111	x	x	x
(8) <u>Operating outlays^c</u>	94	114	96	107	114	110	107	x	x	x
(9) <u>Wages</u>	97	113	97	106	112	107	105	x	x	x
(10) <u>Instruction and research</u>	86	118	90	113	126	122	113	x	x	x
(11) <u>Other</u>	92	111	99	104	109	102	103	x	x	x
(12) <u>Capital outlays^d</u>	73	139	95	128	101	121	130	x	x	x
(13) <u>Unidentified outlays</u>	110	99	125	109	132	133	137	x	x	x

Notes:

x Not available.

^aSum of Rows (4) through (12) in source.

^bSum of Rows (13) through (15) in source.

^cSum of Rows (20) through (28) in source.

^dSum of Rows (29) through (31) in source.

Source:

Table 9.

Table 13

THE USSR ACADEMY OF SCIENCES: EMPLOYMENT
AND EXPENDITURES, 1950-1960

Year	Employment ^a		Expenditures	
	Total ^b	Scientists	Excluding capital	Capital
	(units)		construction	construction ^e
	(1)	(2)	(3)	(4)
1950	18,148	7,590	x	x
1951-1955 total	...	...	4.1 ^c	0.650 ^f
1955	37,257	13,676	(1.0)	x
1956	x	15,716	x	x
1957	x	17,644	x	x
1958	(54,300)	(20,650)	x	0.507 ^g
1959	(61,000)	23,150	1.574 ^d	0.814 ^g
1960	x	23,771	(1.8)	x

Notes:

x Not available.

... Not relevant.

() Provisional estimate.

^aEnd of year.

^bData refer to basic staff (shtatnye rabotniki), and exclude auxiliary workers whose wages are paid from funds designated to maintenance, research operations, capital repair, etc. Inclusive of such workers, total employment in 1955 amounted to "at least 50,000" (VAN, 1956, no. 6, p. 20).

^cDistributed by branch of the Academy as follows (bil.r.): Department of Physics and Mathematics, 0.733; Department of Technical Sciences, 0.520; Department of Biological Sciences, 0.453; Department of Chemistry, 0.415; (regional) Filials, 0.469; all other departments, 1.5.

^dIncluding 0.1875 bil.r. of expenditures on the Siberian Branch.

^eIncluding expenditures on housing and other personnel facilities.

^fAt 1950 prices. The figure includes the value of equipment for newly constructed institutions, but excludes equipment purchased by existing institutions, which amounted to 0.372 bil.r. (included in Col. 3).

^gIncluding expenditures on the Siberian Branch of 0.196 bil.r. in 1958 and 0.418 bil.r. in 1959.

Sources to Table 13:

Col. (1)

1950, 1955: VAN, 1956, no. 11, p. 6.

1958: The percentage increase over 1955 is assumed identical with the percentage increase in the basic staff of the Academy's research institutions (45.7 per cent: VAN, 1959, no. 4, p. 6). In 1955 research institutions accounted for "almost 35,000" (VAN, 1956, no. 3, p. 8), or 94 per cent of the total basic staff. The remaining 6 per cent evidently discharge general administrative functions.

1959: Scientists are assumed to account for 38 per cent of the total (as in 1958).

Col. (2)

1950, 1955: VAN, 1956, no. 6, p. 20.

1956, 1960: From Table 5.

1957: Tsif. -57, p. 365.

1958: Given the figure for 1959, derived from the reported increase over 1959 (2,500: VAN, 1960, no. 4, p. 66).

1959: NKh-59, p. 759.

Col. (3)

1951-1955 total: VAN, 1956, no. 3, p. 10.

1955, 1959: VAN, 1960, no. 4, p. 66. The average annual increase "over the last four years" (presumably the years 1956-1959) was reported as 12.4 per cent.

1960: The reported increase over 1960 was "about 15 per cent" (VAN, 1961, no. 3, p. 12).

Col. (4)

1951-1955 total: VAN, 1956, no. 3, p. 10.

1958-1959: VAN, 1960, no. 4, p. 66.

Table 14
ESTIMATED DISTRIBUTION OF SCIENTISTS IN RESEARCH INSTITUTIONS BY BRANCH AND
JURISDICTION (ALL-UNION OR REPUBLICAN), 1955 AND 1960
(in thousands)

	1955 ^b			1960 ^c		
	USSR	All-Union	Republican	USSR	All-Union	Republican
(1) Total	98	70	28	200	122	78
(2) Industry	37	35	2	74	50	24
(3) Nonindustrial branches	61	35	26	126	72	54
(4) Academies of sciences ^a	22	14	8	42	24	18
(5) Construction and architecture	3	2	1	8	6	2
(6) Transport and communications	3	2	1	5	4	1
(7) Agriculture	11	8	3	20	12	8
(8) Health	10	3	7	13	5	8
(9) Education	2	1	1	4	2	2
(10) Culture and fine arts	6	3	3	9	4	5
(11) Other	4	2	2	25	15	10

Notes:

^a Excluding specialized academies (which are the rows below).

^b 31 December.

^c 1 October.

Sources to Table 14:

1955

USSR

Row (1)

Table 3.

Row (2)

35.4 thousand in research institutes and stations (Table 4) plus an arbitrary allowance for scientists in laboratories and other research institutions (Table 3).

Row (3)

Residual (Row (1) less Row (2)).

Row (4)

Sum of all-Union and republican columns.

Row (5)

2.5 thousand in research institutes and stations (Table 4) plus an arbitrary allowance for scientists in other research institutions (Table 3).

Row (6)

2.8 thousand in research institutes and stations (Table 4) plus an arbitrary allowance for scientists in other research institutions (Table 3).

Row (7)

9.5 thousand in research institutes and stations (Table 4) plus 0.6 thousand in testing and experimental fields and bases, 0.7 thousand in conservation agencies, and an arbitrary allowance for scientists in other research institutions (Table 3).

Row (8)

Zdrav. -57, p. 167.

Row (9)

1.7 thousand in research institutes and stations (Table 4) plus an arbitrary allowance for scientists in other research institutions (Table 3).

Row (10)

0.6 thousand in research institutes and stations (Table 4) plus 3.5 thousand in museums and 2.0 thousand in libraries (Table 3).

Row (11)

Residual (Row (2) less Rows (4) to (10)).

(continued)

Sources to Table 14 (continued)

All-Union and Republican

Row (1)

On the basis of the data in Table 15, average republican outlays per scientist in 1955 are estimated at 55 thousand rubles (see text). Given total republican outlays of 1.558 billion rubles (Table 9), the implied total of scientists under republican jurisdiction is 28 thousand. All-Union scientists derived as a residual (98 less 28).

Row (2)

Although republican industrial ministries accounted for 47 per cent of total industrial output in 1955 (NKh-60, p. 213), the republican share in industrial research is estimated to be very small, since republican jurisdiction was concentrated in low-priority areas where the research effort has presumably been small. In the RSFSR, for example, the eight industrial ministries were: Meat and Dairy Products, Food Products, Industrial Consumer Goods, Local Industry, Fishing, Timber, Building Materials, and Fuel (Zasedaniia Verkhovnogo soveta RSFSR ... 23-26 marta 1955 g., Moscow, 1955, pp. 224-225). Of these, only the fuel industry seems likely to have been involved in much research. Branches prominent in research (machine building, metallurgy, chemicals) were mainly under all-Union jurisdiction.

Row (3)

Residual (Row (1) less Row (2)).

Row (4)

All-Union from Table 13. Republican estimated to be only slightly above the figure for 1 October 1955 (Kul't. stroi. -56, p. 249).

Rows (5)-(10)

Rule-of-thumb distributions. Data on scientists are available only for specialized academies in 1956 (Tsif. -57, p. 286):

	<u>All-Union</u>	<u>Republican</u>
Construction and architecture	952	273
Agriculture	3,719	-
Health	1,910	-
Education	-	504
Culture and fine arts	103	-

Data on research institutions are available only for health: 25 per cent were all-Union in 1956 (Zdrav. -57, p. 164).

Row (11)

Residual (Row (3) less Rows (4) to (10)).

(continued)

Sources to Table 14 (continued)

1960

USSR

Rows (1)-(2)

Table 5.

Row (3)

Residual (Row (1) less Row (2)).

Row (4)

Sum of all-Union and republican columns.

Rows (5)-(7), (9)-(10)

Rule-of-thumb extrapolations from 1955. Data on scientists are available only for specialized academies (see Table 5).

Row (8)

Scientists in research and other institutions (excluding higher educational institutions) numbered 14,692 in 1959 (TsSU, Zdravookhranenie v SSSR, Moscow, 1960, p. 126); the analogous 1960 figure is estimated at 15 thousand. Of this total, around 2 thousand are estimated to have been in clinical institutions and administrative organs (as in 1955 and 1956: Zdrav. -57, p. 167).

Row (10)

Residual (Row (3) less Rows (4) to (10)).

All-Union and Republican

Row (1)

On the basis of the data in Table 15, republican outlays per scientist are estimated at 60 thousand rubles. Given total republican outlays of 4.683 billion rubles (Table 9), the implied total of scientists under republican jurisdiction is 78 thousand. All-Union scientists derived as a residual (200 less 78).

Row (2)

The republican estimate is the sum of scientists in institutions subordinated to regional economic councils (22 thousand from Table 5) and an arbitrary allowance of 2 thousand for industrial research institutions directly subordinated to republican bodies. All-Union scientists derived as a residual (74 less 24).

Row (3)

Residual (Row (1) less Row (2)).

Row (4)

Scientists on 1 October estimated from year-end data for 1959 and 1960. Over the year, scientists in the USSR Academy increased

(continued)

Sources to Table 14 (continued)

from 23,150 to 23,771 (Table 13), and in republican academies from 16,140 (NKh-59, p. 759) to 19,057 (Table 5).

Rows (5)-(10)

Rule-of-thumb distributions. Data on scientists are available only for academies at the end of the year (NKh-60, p. 787):

	<u>All-Union</u>	<u>Republican</u>
Construction and architecture	3,118	1,853
Agriculture	5,103	6,121
Health	2,794	-
Education	-	635
Culture and fine arts	91	-

Row (11)

Residual (Row (3) less Rows (4) to (10)).

Table 15

BUDGET OUTLAYS ON SCIENCE PER SCIENTIST, 1950-1960
(thousand rubles)

	1950	1953	1955	1956	1957	1958	1959	1960
(1) Total budget outlays divided by all scientists in research institutions	76	78	85	97	112	120	122	117
(2) Budget outlays on USSR Academy of Sciences divided by Academy scientists	x	x	73	x	x	x	68	76
(3) Republican budget outlays divided by all scientists in research institutions in the republic								
(a) RSFSR	10	x	8	9	12	16	16	14
(b) All other republics, total	45	x	43	46	53	54	57	50
(c) Ukrainian SSR	39	x	34	x	x	x	x	x
(d) Belorussian SSR	49	x	49	x	x	x	x	x
(e) Uzbek SSR	38	x	40	41	x	x	61	x
(f) Kazakh SSR	54	x	52	54	58	49	x	x
(g) Georgian SSR	49	x	46	49	52	x	x	x
(h) Azerbaidzhan SSR	46	x	44	x	x	x	x	x
(i) Lithuanian SSR	64	x	55	54	x	x	x	x
(j) Moldavian SSR	44	x	39	x	x	x	x	x
(k) Latvian SSR	37	x	45	40	x	56	66	64
(l) Kirgiz SSR	45	x	49	52	x	x	x	x
(m) Tadzhik SSR	60	x	52	x	x	x	x	x
(n) Armenian SSR	69	x	65	74	x	x	x	x
(o) Turkmen SSR	72	x	52	62	x	x	x	x
(p) Estonian SSR	69	x	55	x	x	53	60	x

Note:

x Not available.

Sources to Table 15:

Row (1)

Total budget outlays from Table 8, Col. (3). Scientists in research institutions from Table 2, except 1953 (80.0 thousand, from NKh-58, p. 843).

Row (2)

From Table 13: Col. (3) + Col. (2).

Row (3)

Budget outlays of individual republics from Raskhody-58, p. 42, and Biudzhety-62, p. 51. Scientists in research institutions on territories of the republics in 1950 and 1955 from Kul't. stroi. -56, p. 253; other years as follows:

(a) 1956 from TsSU RSFSR, Kul'turnoe stroitel'stvo RSFSR, Moscow, 1958, p. 389. Later years derived as a residual, given total RSFSR scientists (NKh-58, p. 847, and NKh-60, p. 786) and estimates of scientists in higher educational institutions and administrative organizations. The estimates (together with the firm data for 1956) are as follows (1,000):

	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>
Total RSFSR scientists	166.2	180.4	194.8	212.7	242.9
Higher educational institutions	78.6	(83.0)	(84.5)	(85.6)	(91.1)
Administrative organizations	6.5	(6.0)	(5.6)	(5.6)	(5.5)
Research institutions	81.1	(91.4)	(104.7)	(121.5)	(146.3)

The estimates for higher educational institutions and administrative organizations are guided by the USSR trends (see Table 2), and trends in numbers of students in RSFSR higher educational institutions (NKh-58, p. 831, and NKh-60, p. 759).

(b) Derived as a residual: scientists in all research institutions (Table 2) less those in the RSFSR as estimated above.

(e) TsSU Uzbekskoi SSR, Narodnoe khoziaistvo Uzbekskoi SSR, Tashkent, 1957, p. 184.

(f) TsSU Kazakhskoi SSR, Kazakhstan za 40 let, Alma-Ata, 1960, p. 473.

(g) TsSU Gruzinskoi SSR, Narodnoe khoziaistvo Gruzinskoi SSR, Tbilisi, 1959, p. 343.

(i) TsSU Litovskoi SSR, Narodnoe khoziaistvo Litovskoi SSR, Vil'nius, 1957, p. 195.

(k) TsSU Latviiskoi SSR, Narodnoe khoziaistvo Latviiskoi SSR, Riga, 1957, p. 193, and Latviiskii SSR v tsifrakh v 1960 godu, Riga, 1961, p. 287.

(l) TsSU Kirgizskoi SSR, Narodnoe khoziaistvo Kirgizskoi SSR, Frunze, 1957, p. 202.

(continued)

Sources to Table 15 (continued)

(n) TsSU Armianskoi SSR, Narodnoe khoziaistvo Armianskoi SSR, Erevan, 1957, p. 155.

(o) TsSU Turkmenskoi SSR, Narodnoe khoziaistvo Turkmenskoi SSR, Ashkhabad, 1957, p. 142.

(p) TsSU Estonskoi SSR, Dostizhenia sovetskoi Estonii za 20 let, Tallin, 1960, p. 99.

Table 16

BUDGET OUTLAYS PER SCIENTIST IN 1955 AND 1960, ASSUMING
"UNIDENTIFIED" OUTLAYS ARE FOR INDUSTRIAL RESEARCH

	Scientists ^a (1,000)	Budget outlays (bil.r.)	Outlays per scientist (1,000 r.)
<u>1955</u>			
(1) USSR total	97.8	8.247	84 ^b
(2) All-Union total	70	6.689	96
(3) Nonindustrial	35	2.223	64
(4) Academy of Sciences	14	1.0	73 ^c
(5) Other	21	1.2	57
(6) Industrial	35	4.466	128
(7) Republican total	28	1.558	55
<u>1960</u>			
(8) USSR total	200.1	23.389	117
(9) All-Union total	122	18.706	153
(10) Nonindustrial	72	(4.7)	65
(11) Academy of Sciences	24	1.8	76 ^c
(12) Other	48	(2.9)	60
(13) Industrial	50	(14.0)	280
(14) Republican total	78	4.683	60

Notes:

^a1955 figures refer to end of year, 1960 figures to 1 October.

^bThe figure is slightly below that shown in Table 15, where (for consistency with the rest of the row) the 1955 calculation is based on the number of scientists on 1 October.

^cComputed from unrounded data for scientists.

Sources:

Number of scientists from Table 14. Budget outlays from Tables 9 and 13.

SOURCES CITED IN ABBREVIATED FORM

- Aleksandrov-61 A. M. Aleksandrov (ed.). Gosudarstvennyi biudzhет SSSR, Moscow, 1961.
- Ananov-60 I. N. Ananov. Ministerstva v SSSR, Moscow, 1960.
- Biudzhety-62 Ministerstvo finansov SSSR. Gosudarstvennyi biudzhет SSSR i biudzhety soiuznykh republik, Moscow, 1962.
- BSE Bol'shaia sovetskaia entsiklopediia.
- DeWitt-61 Nicholas DeWitt, "Reorganization of Science and Research in the USSR," Science, 23 June 1961, pp. 1981-1991.
- Dostizheniia-57 Tsentral'noe statisticheskoe upravlenie. Dostizheniia sovetskoi vlasti za sorok let v tsifrakh, Moscow, 1957.
- Ezhegodnik BSE-57 Ezhegodnik Bol'shoi sovetskoi entsiklopedii 1957, Moscow, 1957.
- Fed'kin-58 G. I. Fed'kin. Pravovye voprosy organizatsii nauchnoi raboty v SSSR, Moscow, 1958.
- Kap. stroi. -61 Tsentral'noe statisticheskoe upravlenie. Kapital'noe stroitel'stvo v SSSR, Moscow, 1961.
- Komarov-59 V. E. Komarov. Ekonomicheskie osnovy podgotovki spetsialistov dlia narodnogo khoziaistva, Moscow, 1959.
- Kul't. stroi. -40 Tsentral'noe upravlenie narodno-khoziaistvennogo ucheta. Kul'turnoe stroitel'stvo SSSR, Moscow, 1940.
- Kul't. stroi. -56 Tsentral'noe statisticheskoe upravlenie. Kul'turnoe stroitel'stvo SSSR, Moscow, 1956.
- Nar. obraz. -57 I. A. Kairov and others (ed.). Narodnoe obrazovanie v SSSR, Moscow, 1957.
- NKh-55 Tsentral'noe statisticheskoe upravlenie. Narodnoe khoziaistvo SSSR, Moscow, 1956.
- NKh-56 Tsentral'noe statisticheskoe upravlenie. Narodnoe khoziaistvo SSSR v 1956 godu, Moscow, 1957.
- NKh-58 Tsentral'noe statisticheskoe upravlenie. Narodnoe khoziaistvo SSSR v 1958 godu, Moscow, 1959.
- NKh-59 Tsentral'noe statisticheskoe upravlenie. Narodnoe khoziaistvo SSSR v 1959 godu, Moscow, 1960.
- NKh-60 Tsentral'noe statisticheskoe upravlenie. Narodnoe khoziaistvo SSSR v 1960 godu, Moscow, 1961.

Sources (continued)

PKh Planovoe khoziaistvo.

Plotnikov-48 K. N. Plotnikov. Biudzhets sotsialisticheskogo gosudarstva, Moscow, 1948.

Plotnikov-54 K. N. Plotnikov. Ocherki istorii biudzheta sovetskogo gosudarstva, Moscow, 1954.

Raskhody-58 Ministerstvo finansov SSSR. Raskhody na sotsial'no-kul'turnye meropriiatiia po gosudarstvennomu biudzhetu SSSR, Moscow, 1958.

SKh-60 Tsentral'noe statisticheskoe upravlenie. Sel'skoe khoziaistvo SSSR, Moscow, 1960.

Tsif. -57 Tsentral'noe statisticheskoe upravlenie. SSSR v tsifrakh, Moscow, 1958.

Tsif. -61 Tsentral'noe statisticheskoe upravlenie. SSSR v tsifrakh v 1961 godu, Moscow, 1962.

VAN Vestnik Akademii nauk SSSR.

Vys. shkola-57 Ministerstvo vysshego obrazovaniia SSSR. Vysshaia shkola: osnovnye postanovleniia, prikazy i instruktsii, Moscow, 1957.

Zasedaniia-46 Zasedaniia Verkhovnogo soveta SSSR...15-18 oktiabria 1946 g., Moscow, 1946.

Zasedaniia-51 Zasedaniia Verkhovnogo soveta SSSR...6-12 marta 1951 g., Moscow, 1951.

Zdrav. -57 Ministerstvo zdravookhraneniia SSSR. Zdravookhranenie v SSSR, Moscow, 1957.

Zverev-46 A. G. Zverev. Gosudarstvennye biudzhety Soiuza SSR, 1938-1945 gg., Moscow, 1946.